This is a digital document from the collections of the Wyoming Water Resources Data System (WRDS) Library.

For additional information about this document and the document conversion process, please contact WRDS at wrds@uwyo.edu and include the phrase “Digital Documents” in your subject heading.

To view other documents please visit the WRDS Library online at: http://library.wrds.uwyo.edu

Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)
BIDDING DOCUMENTS
CONTRACT DOCUMENTS
SPECIFICATIONS

STATE OF WYOMING
WATER DEVELOPMENT COMMISSION

DEER CREEK
DAM PROJECT

MAY, 1986

BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS
620 PLAZA COURT • P.O. BOX 550 • LARAMIE, WY 82070 • (307) 745-7366
CONTRACT DOCUMENTS AND SPECIFICATIONS
FOR
DEER CREEK DAM

THE STATE OF WYOMING WATER DEVELOPMENT COMMISSION
PROJECT NO. 2211-40

ENGINEER:
Banner Associates, Inc.
620 Plaza Court
P.O. Box 550
Laramie, WY 82070
Phone: (307)745-7366

1986
# TABLE OF CONTENTS

**BIDDING REQUIREMENTS**  
- Invitation to Bid  
- Instructions to Bidders  
- Bid Form  
- Prebid Conference Certificate  
- Resident Questionnaire  
- Bid Schedule  
- Bid Item Descriptions

**Conditions of Contract**  
- General Conditions  
- Supplemental Conditions  
- Agreement  
- Construction Performance Bond  
- Construction Payment Bond  
- Certificate of Substantial Completion  
- Certificate of Contractor  
- Waiver and Release of Lien

**Specifications**

**Division 1 - General Requirements**

- 1A - Summary of Work  
- 1B - Alternates  
- 1C - Progress and Payment  
- 1D - Submittals  
- 1E - Rules Governing Testing and Inspection  
- 1F - Permits  
- 1G - Material and Equipment  
- 1H - Project Closeout  
- 1I - Temporary Facilities and Controls  
- 1J - Environmental Quality Protection  
- 1K - Liquidated Damages  
- 1L - Hydrologic Data

**Division 2 - Sitework**

- 2A - Temporary Environmental Protection Measures at the Dam Site and Diversion and Care of Deer Creek  
- 2B - Clearing and Grubbing  
- 2C - Excavation - Open Cut  
- 2D - Pressure Grouting  
- 2E - Dam Instrumentation  
- 2F - Fill Placement  
- 2G - Waste Material Disposal  
- 2H - Chain Link Security Fence and Access Control Gate
DIVISION 2 - SITEWORK (CONTINUED)

2I - ROCK REINFORCEMENT OPEN CUT EXCAVATIONS
2J - TUNNEL AND SHAFT EXCAVATION AND SUPPORT
2K - EMERGENCY ACCESS TRAIL
2L - COFFERDAM OUTLET WORKS
2M - PROJECT IDENTIFICATION SIGNS
2N - TOPSOIL STRIPPING
2O - REMOVAL OF STRUCTURES AND OBSTRUCTIONS
2P - SITE GRADING FOR ACCESS ROADS, PARKING LOTS, AND BOAT RAMP
2Q - AGGREGATES FOR ACCESS ROADS, PARKING LOTS, BOAT RAMP, AND GAGING STATIONS
2R - EXCAVATION AND BACKFILL FOR CULVERTS, CATTLEGUARDS, AND GAGING STATION STRUCTURES
2S - GABIONS
2T - ENGINEERING FABRIC FOR ROADS
2U - OBLITERATION OF ABANDONED ROADWAYS
2V - SEEDING AND MULCHING
2W - CATTLEGUARDS
2X - GUARDRAIL
2Y - BARBED WIRE FENCE
2Z - CULVERTS AND STOCKPASSES
2AA - TRAFFIC CONTROL SIGNS
2BB - GAGE HOUSE SHELTERS, STILLING WELLS, AND APPURTEANCES
2CC - GAGING STATION CONTROL STRUCTURES
2DD - GAGING STATION CABLEWAY
2EE - DIVERSION AND CARE OF STREAMS ADJACENT TO OR CROSSING ACCESS ROADS AND GAGING STATIONS
2FF - BOAT RAMP AND PARKING LOTS
2GG - REVEGETATION OF DAM AREA
2HH - TRAFFIC CONTROL DURING CONSTRUCTION
2II - TYPE 1 FIELD LABORATORY
2JJ - DESIGNATED HAUL ROAD MAINTENANCE
2KK - UPPER PLUNGE POOL UNDERDRAIN

DIVISION 3 - CONCRETE

3A - CONCRETE FORMWORK
3B - CONCRETE REINFORCEMENT
3C - CAST-IN-PLACE CONCRETE
3D - CONCRETE APPURTEANCES
3E - SHOTCRETE

DIVISION 4 - MASONRY

4A - UNIT MASONRY

DIVISION 5 - METALS

5A - STRUCTURAL STEEL
5B - MISCELLANEOUS METAL
DIVISION 6 - WOOD AND PLASTICS

6A - LUMBER

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

7A - DAMPPROOFING
7B - SHEET METALWORK, GENERAL
7C - BUILDING INSULATION
7D - ADHERED ELASTOMERIC ROOFING SYSTEM
7E - SEALANT

DIVISION 8 - DOORS AND WINDOWS

8A - METAL DOORS, FRAMES, AND HARDWARE
8B - OVERHEAD COILING DOOR

DIVISION 9 - FINISHES

9A - GYPSUM WALLBOARD (DRY WALL)
9B - PAINTING

DIVISION 10 - SPECIALTIES

10A - 48-INCH CONE VALVES WITH ELECTRIC OPERATORS
10B - 42-INCH FIXED-CONE DISPERSION VALVES WITH ELECTRIC OPERATORS
10C - 24-INCH ANGLE PATTERN POLYJET VALVES WITH ELECTRIC OPERATORS
10D - 30-INCH GATE VALVE WITH ELECTRIC OPERATORS
10E - 36-INCH GATE VALVES WITH ELECTRIC OPERATORS
10F - 36-INCH VENTURI TUBES
10G - STEEL PIPE AND WYE BRANCHES
10H - CONTROL BUILDING INTERIOR PIPING, FITTINGS, AND APPURTENANCES
10I - STEEL TUNNEL LINER
10J - 24-INCH GATE VALVES WITH MANUAL OPERATORS
10K - DIVERSION TUNNEL - 24-INCH STEEL PIPE
10L - STREAM GAGING EQUIPMENT

DIVISION 11 - EQUIPMENT

NOT APPLICABLE FOR THIS PROJECT

DIVISION 12 - FURNISHINGS

NOT APPLICABLE FOR THIS PROJECT

DIVISION 13 - SPECIAL CONSTRUCTION

NOT APPLICABLE FOR THIS PROJECT

DIVISION 14 - CONVEYING SYSTEMS

14A - CRANE AND CRANE BRIDGE
14B - GONDOLA SYSTEM
14C - CONTROL BUILDING VEHICLE
DIVISION 15 - MECHANICAL

15A - MECHANICAL, GENERAL REQUIREMENTS
15B - MECHANICAL, PLUMBING
15C - MECHANICAL, INSULATION
15D - MECHANICAL, HEAT GENERATION
15E - MECHANICAL, AIR DISTRIBUTION
15F - MECHANICAL, TEMPERATURE AND VENTILATION CONTROL
15G - MECHANICAL, LIQUIFIED PETROLEUM GAS STORAGE

DIVISION 16 - ELECTRICAL

16A - ELECTRICAL, GENERAL REQUIREMENTS
16B - ELECTRICAL, BASIC MATERIAL AND METHODS
16C - ELECTRICAL, SERVICE AND DISTRIBUTION
16D - ELECTRICAL, GENERAL LIGHTING
16E - ONSITE POWER GENERATION
16F - INSTRUMENTATION AND CONTROL SYSTEMS
BIDDING REQUIREMENTS
INVITATION TO BID

Notice is hereby given that the State of Wyoming, Water Development Commission will receive bids for the Deer Creek Dam. The construction shall consist of a 280 foot high concrete faced, rock filled dam; a cascade spillway; a 2,000 foot diversion tunnel; control works; seven gaging stations; sixteen miles of roads; telemetry and control systems; and a concrete boat ramp.

The bids must be furnished on forms supplied by the Water Development Commission and submitted in a sealed envelope to the State of Wyoming, Water Development Commission, Herschler Building, Cheyenne, Wyoming, 82002, not later than ______________(Local Time) at which time all bids will be publicly opened and read aloud in the presence of the bidders and their representatives. The bids will be opened in the ______________. No bids will be accepted after the specified hour and date and will be returned to the Bidder(s) unopened. Bids which are not prepared and filed in accordance with the Instructions to Bidders may be rejected. Bids will be considered by the Water Development Commission at its meeting on ______________.

A Prebid Conference has been scheduled to provide for identification and discussion of potential problems which might arise during the administration of any subsequent contract. ALL POTENTIAL BIDDERS ARE REQUIRED TO ATTEND THE PREBID CONFERENCE. No Bid will be accepted from any Bidder who does not attend such conference. The Prebid Conference will be held at _____ a.m. on the _____ day of _______ at ______________. Representatives of the Owner and Engineer will be present to discuss the Project.

All bids must be accompanied by a bid bond in the amount of not less than five percent (5%) of the total sum of the bid, payable to the State of Wyoming, Water Development Commission. The Bid bond shall be accompanied by a certified copy of Power of Attorney. The bid guarantee will be retained by said Commission as liquidated damages if the successful bidder refuses or fails to enter into an Agreement within fifteen (15) days after Notice of Award or fails at time of executing the contract to furnish a construction performance bond and construction payment bond guaranteeing the faithful performance of the work.

A complete set of Plans, Specifications, and Contract Documents may be obtained at the office of Banner Associates, Inc., 620 Plaza Court, P. O. Box 550, Laramie, Wyoming, 82070. Copies may be obtained upon payment of $100.00 for half-size plans, $125.00 for full-size plans, $75.00 per set of specifications, and $10.00 per set of Bidding Documents. Payment is non-refundable.

The Bidder to whom the contract is awarded will be required to furnish a construction performance bond and a construction payment bond to the State of Wyoming, Water Development Commission in the amount of one hundred percent (100%) of the contract award for each bond, in conformance with the requirements of the Contract Documents. The construction performance bond and construction payment bond shall remain in full force until the completion of the Contract as specified in the General Conditions.
Bids may not be withdrawn after the time fixed for opening them. The State of Wyoming Water Development Commission reserves the right to reject any and all bids, and to waive any irregularities therein.

Responsible resident bidders will receive a five percent (5%) preference in accordance with Wyoming State Statute 16-6-102:

".....the contract shall be let to the responsible resident making the lowest bid if the resident's bid is not more than five percent (5%) higher than that of the lowest responsible nonresident bidder."

Certification of resident status must be submitted with the Bid, on the form included with the Bidding Documents.

STATE OF WYOMING
WATER DEVELOPMENT COMMISSION

Michael K. Purcell, Administrator
INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS.

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract (No. 1910-8, 1983 ed.) have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement or Invitation to Bid, Instructions to Bidders, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

2. COPIES OF BIDDING DOCUMENTS.

2.1 Complete sets of the Bidding Documents in the number and for the sum stated in the Advertisement or Invitation to Bid may be obtained from Engineer. Payment is non-refundable.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3 Owner and Engineer in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

2.4 The following are part and parcel of the Agreement, and whenever the word "Agreement" or "Contract Documents" appears herein, the same shall be held to include all of these items:

- Bid Form
- Agreement
- Construction Performance Bond
- Construction Payment Bond
- General Conditions
- Supplementary Conditions
- Specifications
- Drawings
- Addenda
- All Amendments, Modifications, or Supplements as may be issued

3. QUALIFICATIONS OF BIDDERS. (Not Applicable)
4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE.

4.1 It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors or discrepancies in the Contract Documents.

4.2 Reference is made to the Supplementary Conditions for identification of:

4.2.1 those reports of explorations and test of subsurface conditions at the site which have been utilized by Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such reports but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.

4.2.2 those drawings of physical conditions in or relating to existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site which have been utilized by Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such drawings but not upon the completeness thereof for the purposes of bidding or construction.

Copies of such reports and drawings will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the technical data contained therein upon which Bidder is entitled to rely as provided in Paragraphs 4.2.1 and 4.2.2 are incorporated therein by reference. Such technical data has been identified and established in the Supplementary Conditions.

4.3 Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities or others, and Owner and Engineer do not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear on Paragraphs 4.2 and 4.3 of the General Conditions.

4.5 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.
4.6 On request in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

4.7 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

4.8 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. **INTERPRETATIONS AND ADDENDA.**

5.1 All questions about the meaning or intent of the Contract Documents are to be directed to Engineer. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than ten days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer.

6. **BID SECURITY.**

6.1 Each Bid must be accompanied by Bid security made payable to Owner in an amount of five percent of the Bidder's maximum Bid price and in the form of a Bid Bond issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions. The Bid Bond shall be accompanied by a certified copy of Power of Attorney.

6.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other bidders whom Owner believes to have a
reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Agreement or the forty-sixth day after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within seven days after the Bid opening.

7. CONTRACT TIME.

The numbers of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Bid Form and the Agreement.

8. LIQUIDATED DAMAGES.

Provisions for liquidated damages, if any, are set forth in the Agreement and General Requirements, Section 1K.

9. SUBSTITUTE OR "OR-EQUAL" ITEMS.

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Paragraphs 6.7.1, 6.7.2, and 6.7.3 of the General Conditions and may be supplemented in the General Requirements.

10. SUBCONTRACTORS, SUPPLIERS, AND OTHERS.

10.1 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other persons and organizations (including those who are to furnish the principal items of material and equipment) to be submitted to Owner in advance of the specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within seven days after the Bid opening submit to Owner a list of all such Subcontractors, Suppliers and other persons and organizations proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, person or organization if requested by Owner. If Owner or Engineer after due investigation has reasonable objection to any proposed Subcontractor, Supplier, other person or organization, either may before the Notice of Award is given request the apparent Successful Bidder to submit an acceptable substitute
in which case the apparent Successful Bidder shall submit an acceptable substitute, that Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution and Owner may consider such price adjustment in evaluating Bids and making the contract award.

or

without an increase in Bid price.

If apparent Successful Bidder declines to make any such substitution, Owner may award the contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Bidder. Any Subcontractor, Supplier, other person or organization listed and to whom Owner or Engineer does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.8.2 of the General Conditions.

10.2 No Contractor shall be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.

11. **BID FORM.**

11.1 Bids shall be submitted on the Bid Form and attachments furnished by the Engineer, sample copies of which are bound herein. Sample copies of forms shall not be used for submittal of a Bid. Complete Bid Form packages are available upon payment of $10.00, including an envelope in which the Bid Form and attachments shall be placed for submittal. The name of the Bidder and checklist on the outside of the envelope shall be clearly marked.

11.2 All blanks on the Bid Form must be completed in ink or by typewriter.

11.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

11.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be typed or printed below the signature.

11.6 The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).
11.7 The address and telephone number for communications regarding the Bid must be shown.

12. **SUBMISSION OF BIDS.**

Bids shall be submitted at the time and place indicated in the Advertisement or Invitation to Bid and shall be enclosed in the furnished sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

Bids shall be submitted on the unbound Bid Forms as described in paragraph 11.1. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the following data:

- Resident Questionnaire
- Pre-Bid Conference Certificate
- Bid Schedule
- Certified Copy of Power-of-Attorney for Bid Bond

13. **MODIFICATION AND WITHDRAWAL OF BIDS.**

13.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

13.2 If, within twenty-four hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

14. **OPENING OF BIDS.**

Bids will be opened and (unless obviously non-responsive) read aloud publicly. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders after the opening of Bids.

15. **BIDS TO REMAIN SUBJECT TO ACCEPTANCE.**

All bids will remain subject to acceptance for forty-five days after the day of Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.
16. **AWARD OF CONTRACT.**

16.1 Owner reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional Bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.2 In evaluating Bids, Owner will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

16.3 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

16.4 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner’s satisfaction within the prescribed time.

16.5 The Owner will require a conference with the apparent low Bidder to assure a full and complete understanding of the obligations of the Contractor under a resulting Agreement. All Bidders are requested to discuss the potential for a Preaward Conference at the Prebid Conference which together shall serve as the basis for resolution of ambiguities and the potential for disputes prior to award or during the administrative phase of the Agreement. The Water Development Commission believes that these additional measures shall assist all Bidders on Bidding on a free, open and competitive basis with all Bidders fully understanding the nature of the work to be performed under the resulting Agreement.

Within seven (7) days after Bid opening, the apparent low Bidder shall provide a list of all proposed subcontractors and supplies of principal items of equipment and material, including, at minimum, control valves, tunnel lining, bifurcations, piping, meters, concrete, and gondola. The apparent low Bidder shall also cooperate fully with the Engineer during the pre-award investigation and provide all information as requested on Owner’s behalf.
16.6 If the contract is to be awarded, it will be awarded to the lowest Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.

16.7 If the contract is to be awarded, Owner will give the successful Bidder a Notice of Award within forty-five days after the day of the Bid opening.

17. CONTRACT SECURITY.

Paragraph 5.1 of the General Conditions and the Supplementary Conditions set forth Owner’s requirements as to performance and payment Bonds. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required performance and payment Bonds.

18. SIGNING OF AGREEMENT.

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen days thereafter Contractor shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds. Within ten days thereafter Owner shall deliver one fully signed counterpart to Contractor. Each counterpart is to be accompanied by a complete set of the Drawings with appropriate identification.

19. PREBID CONFERENCE.

A mandatory Prebid Conference will be held at _________ a.m. on the ____ day of ________, at __________. Representatives of Owner and Engineer will be present to discuss the Project. A Prebid Conference has been scheduled to provide for identification and discussion of potential problems which might arise during the administration of any subsequent Agreement. ALL POTENTIAL BIDDERS ARE REQUIRED TO ATTEND THIS CONFERENCE. No Bid will be received from any Bidder who does not attend such conference. Prior to admission to such Prebid Conference any potential Bidder will be required to sign and furnish the Prebid Conference Certificate. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference.

20. RETAINAGE.

Provisions concerning retainage and Contractor’s rights to deposit securities in lieu of retainage are set forth in the Agreement.
BID FORM

PROJECT IDENTIFICATION:
Deer Creek Dam Project

CONTRACT IDENTIFICATION AND NUMBER:

THIS BID IS SUBMITTED TO:
State of Wyoming
Water Development Commission
Herschler Building, Third Floor East
Cheyenne, Wyoming 82002

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for forty-five days after the day of Bid opening. BIDDER will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen days after the date of OWNER's Notice of Award.

3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:

   a. BIDDER has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

   Date  Number

   ________________________________
   ________________________________
   ________________________________
   ________________________________

   b. BIDDER has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.
c. BIDDER has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in paragraph 4.2 of the General Conditions, and accepts the determination set forth in paragraph SC-4.2 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which BIDDER is entitled to rely.

d. BIDDER has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in (c) above) which pertain to the subsurface or physical conditions at the site or otherwise may affect the cost, progress, performance or furnishing of the Work as BIDDER considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provision of paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by BIDDER for such purposes.

e. BIDDER has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by BIDDER in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.3 of the General Conditions.

f. BIDDER has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

g. BIDDER has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER.

h. BIDDER has attended Prebid Conference and has submitted a copy of the Prebid Conference Certificate herewith.

i. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.
4. BIDDER will complete the Work for the following prices as summarized in the attached Bid Schedule. The Bid Schedule is considered to be part of the Bid Form.

TOTAL OF UNIT PRICES

($_______)

(leave words)

Quantities are not guaranteed. Final payment will be based on actual quantities.

5. BIDDER agrees that the Work will be substantially complete on or before __________, 19____ and completed and ready for final payment in accordance with paragraph 14.13 of the General Conditions on or before __________, 19____.

BIDDER accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

6. The following documents are attached to and made a conditions of this Bid and are considered to be part of the Bid Form:

   a. Required Bid security made payable to the Owner in an amount of five percent of the Bidder's maximum Bid price and in the form of a Bid Bond issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions. The Bid Bond shall be accompanied by a certified copy of Power-of-Attorney.

b. Bid Schedule.

c. Resident Questionnaire.

d. Pre-Bid Conference Certificate.

7. Communications concerning this Bid shall be addressed to:

The address of BIDDER indicated on the following page;

or,

The following address:

____________________________________________________
____________________________________________________

8. The terms used in this Bid which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED on __________________________, 19____.
If BIDDER is:

An Individual
By ____________________________ (SEAL)
(Individual's Name)
doing business as ________________________________________________
Business address: ________________________________________________
Phone No.: ______________________________________________________

A Partnership
By ____________________________ (SEAL)
(Firm Name)
(general partner)
Business address: ________________________________________________
Phone No.: ______________________________________________________

A Corporation
By ____________________________ (Corporation Name)
(STATE OF INCORPORATION)
By ____________________________ (name of person authorized to sign)
(TITLE)
(Corporate Seal)
Attest ____________________________ (Secretary)
Business address: ________________________________________________
Phone No.: ______________________________________________________

A Joint Venture
By ____________________________ (Name)
(Address)
By ____________________________ (Name)
(Address)

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above.)
PREBID CONFERENCE CERTIFICATE

, hereby certifies that as a condition to admission to the Prebid Conference for the Deer Creek Dam Project that:

1. intends to submit a Bid in accordance with the Bidding Requirements of this solicitation. However, said prospective bidder is not required to submit a Bid if he so elects.

2. Bidder who attend the Prebid Conference without having fully developed an integrated plan for accomplishment of the provisions of the Contract Documents and their integration into the total design will be at a procedural prebid disadvantage to those who do. It is the purpose of the Prebid Conference to assist Bidders in achieving quality performance under this Agreement by a full and complete understanding of the design. Bidders should treat this matter as if final bids were required on the date of the Prebid Conference. By being so prepared, then each Bidder will be able to raise questions concerning any matter which was unclear in the Bidding process or which had to be evaluated on the basis of subjective judgment of the Bidder. All Bidders are cautioned to raise these questions.

3. That such Bidder recognizes that the purpose of the Prebid Conference is to resolve ambiguities, inconsistencies, errors, or omissions in such Drawings or Specifications.

4. That if subsequent to the award of any Agreement, as a result of a need to interpret, enforce, or otherwise resolve any ambiguity, inconsistency, error, or omission in the Drawings and Specifications, such interpretation, enforcement, or resolution shall be made with a preference to accomplishment of the purpose of the Agreement, without additional cost to the Owner. If by any reasonable inference, the basis for such action could have been raised and resolved at the Prebid Conference.

5. That this Certificate is a material requirement of the solicitation and shall remain a material covenant of the resulting Agreement. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the Prebid Conference so that all Bidders may bid on an equal basis, free from error and with a clear understanding of the requirements of this Agreement.

All Bidders are cautioned to read Article 1 - General, of the Supplemental Conditions hereof.

______________________________
Signature

Date __________________________

B-5
RESIDENT QUESTIONNAIRE - WYOMING

SECTION 16-6-101 WYOMING STATUTES, PROVIDES:

"As used in this act (16-6-101 to 16-6-104) the word "resident" means: Any person who shall have been a bona fide resident of the state for one year or more immediately prior to bidding upon the contract; a partnership or association, each member of which shall have been a bona fide resident of the state for one year or more immediately prior to bidding upon the contract; a corporation which has been organized under the laws of the State of Wyoming and has been in existence therein for one year or more immediately prior to bidding upon the contract and which has its principle (principal) office and place of business within the State of Wyoming."

DO YOU CLAIM RESIDENCE UNDER THIS STATUTE

Length of Residence in Wyoming: [ ] YES ( ) NO ( )

INDIVIDUAL:

Name

Home Address: Street
City
Zip

Signed: ____________________________
Date: ___________________________

PARTNERSHIP OR ASSOCIATION:

Partner

Home Address: Street
City
Zip

Partner

Home Address: Street
City
Zip

Signed: ____________________________
Date: ___________________________

CORPORATION: NAME

Date organized under State Laws of Wyoming

Principal Office

Principal Place of Business

Street
City
State
Zip

Signed
Corporation Officer

R-1
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>UNIT</th>
<th>ESTIMATED QUANTITY</th>
<th>UNIT PRICE (IN WRITTEN WORDS)</th>
<th>UNIT PRICE (FIGURES)</th>
<th>AMOUNT BID (FIGURES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MOBILIZATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TEMPORARY ENVIRONMENTAL PROTECTION MEASURES AT THE DAM Site AND DIVERSION AND CARE OF DEER CREEK</td>
<td>FA</td>
<td></td>
<td>Force Account</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CLEARING</td>
<td>ACRE</td>
<td>55.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>GRUBBING</td>
<td>ACRE</td>
<td>27.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>STEEL PIPE, 24&quot;</td>
<td>LF</td>
<td>1588</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>GATE VALVE, 24&quot;</td>
<td>EA</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>UPSTREAM COFFER DAM OUTLET WORKS</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DOWNSTREAM COFFER DAM OUTLET WORKS</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>DESIGNATED HAUL ROAD MAINTENANCE</td>
<td>FA</td>
<td></td>
<td>Force Account</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>EXCAVATION, TUNNEL AND SHAFT</td>
<td>LF</td>
<td>2330</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>SHAFT SETS, CIRCULAR</td>
<td>EA</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>TUNNEL SETS, STANDARD MODIFIED HORSESHOE</td>
<td>EA</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>TUNNEL SETS, EXTENDED MODIFIED HORSESHOE</td>
<td>EA</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>EXCAVATION, COMMON</td>
<td>CY</td>
<td>100,600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>EXCAVATION, ROCK</td>
<td>CY</td>
<td>974,800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>FILL PLACEMENT, ZONE 1</td>
<td>CY</td>
<td>29,200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>FILL PLACEMENT, ZONE 2</td>
<td>CY</td>
<td>65,400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>FILL PLACEMENT, ZONE 2A</td>
<td>CY</td>
<td>2100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>FILL PLACEMENT, ZONE 3</td>
<td>CY</td>
<td>768,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>FILL PLACEMENT, ZONE 3A</td>
<td>CY</td>
<td>426,900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>FILL PLACEMENT, ZONE 4</td>
<td>CY</td>
<td>37,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>ITEM NO.</td>
<td>UNIT</td>
<td>ESTIMATED QUANTITY</td>
<td>UNIT PRICE (IN WRITTEN WORDS)</td>
<td>UNIT PRICE (FIGURES)</td>
<td>AMOUNT BID (FIGURES)</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>32</td>
<td>32</td>
<td>CY</td>
<td>23,200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>33</td>
<td>CY</td>
<td>4800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>34</td>
<td>CY</td>
<td>710</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>SY</td>
<td>27,120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>36</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>37</td>
<td>ACRE</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>EA</td>
<td>436</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>51</td>
<td>EA</td>
<td>1760</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>52</td>
<td>EA</td>
<td>576</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>53</td>
<td>LF</td>
<td>3720</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>54</td>
<td>LF</td>
<td>3570</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>55</td>
<td>LF</td>
<td>3420</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>56</td>
<td>LF</td>
<td>1830</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>57</td>
<td>LF</td>
<td>710</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>58</td>
<td>LF</td>
<td>12,210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>59</td>
<td>LF</td>
<td>4390</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>ITEM</td>
<td>UNIT</td>
<td>ESTIMATED QUANTITY</td>
<td>UNIT PRICE (IN WRITTEN WORDS)</td>
<td>UNIT PRICE (FIGURES)</td>
<td>AMOUNT BID (FIGURES)</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------</td>
<td>------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>60</td>
<td>DRILLING PRESSURE GROUT HOLES, PLINTH &amp; TUNNEL 80'-130'</td>
<td>LF</td>
<td>790</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>DRILLING PRESSURE GROUT HOLES, PLINTH &amp; TUNNEL 130'-180'</td>
<td>LF</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>DRILLING PRESSURE GROUT HOLES, PLINTH &amp; TUNNEL 180'-250'</td>
<td>LF</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>PRESSURE GROUTING</td>
<td>SACK</td>
<td>30,640</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>FURNISHING AND HANDLING CEMENT FOR PRESSURE GROUTING</td>
<td>SACK</td>
<td>30,640</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>WATER TESTING FOR PRESSURE GROUTING</td>
<td>HR</td>
<td>280</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>PLINTH CONCRETE, CLASS B WITH FIBERS</td>
<td>CY</td>
<td>2110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>FACE SLAB CONCRETE, CLASS B WITH FIBERS</td>
<td>CY</td>
<td>9575</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>CREST WALL CONCRETE, CLASS B WITH FIBERS</td>
<td>CY</td>
<td>1327</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>CONCRETE, CLASS C</td>
<td>CY</td>
<td>280</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>SHOTCRETE</td>
<td>CY</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>ROCK ANCHOR, UNTENSIONED Ø8</td>
<td>LF</td>
<td>44,112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>ROCK ANCHOR, UNTENSIONED Ø10</td>
<td>LF</td>
<td>19,650</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>ROCK BOLT, PRETENSIONED Ø8</td>
<td>LF</td>
<td>10,608</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>PRESUPPORT ROCK DOWEL, UNTENSIONED Ø8</td>
<td>LF</td>
<td>13,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>INTAKE STRUCTURE</td>
<td>LS</td>
<td>Lump Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>TUNNEL LINING</td>
<td>LF</td>
<td>1034</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>CONTROL BUILDING</td>
<td>LS</td>
<td>Lump Sum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>ITEM</td>
<td>UNIT</td>
<td>ESTIMATED QUANTITY</td>
<td>UNIT PRICE (IN WRITTEN WORDS)</td>
<td>UNIT PRICE (FIGURES)</td>
<td>AMOUNT (FIGURES)</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------</td>
<td>------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>103</td>
<td>STAND-BY POWER BUILDING</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>SPILLWAY</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>GONDOLA SYSTEM</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>BOAT RAMP</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>CHAIN LINK FENCE</td>
<td>LF</td>
<td></td>
<td>650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>DAM INSTRUMENTATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>TELEMETRY, INSTRUMENTATION, AND CONTROL</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>DUCK CREEK GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>DAVIS CREEK GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>DEER CREEK ABOVE RESERVOIR GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>WEST FORK DEER CREEK GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>DEER CREEK IN CANYON GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>KING CREEK GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>DEER CREEK IN GLENROCK GAGING STATION</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>REMOVAL OF STRUCTURES AND OBSTRUCTIONS</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>FIELD LABORATORY, TYPE I</td>
<td>LS</td>
<td></td>
<td>Lump Sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>TRAFFIC CONTROL</td>
<td>FA</td>
<td></td>
<td>Force Account</td>
<td></td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>SITE GRADING, COMMON</td>
<td>CY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>SITE GRADING, ROCK</td>
<td>CY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>SITE GRADING, UNCLASSIFIED</td>
<td>CY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>SEEDING AND MULCHING</td>
<td>ACRE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>ITEM</td>
<td>UNIT</td>
<td>ESTIMATED QUANTITY</td>
<td>UNIT PRICE (IN WRITTEN WORDS)</td>
<td>UNIT PRICE (FIGURES)</td>
<td>AMOUNT BID (FIGURES)</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------------</td>
<td>-------</td>
<td>--------------------</td>
<td>--------------------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>137</td>
<td>EXCELSIOR MATTING</td>
<td>ACRE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>ENGINEERING FABRIC</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>CRUSHED AGGREGATE SURFACE COURSE</td>
<td>TON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>CMP 18&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>CMP 24&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>CMP 30&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>CMP 36&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>CMP 42&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>CMP 48&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>CMP 60&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>147</td>
<td>CMP 84&quot;</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>148</td>
<td>CMP 5'-10&quot; x 8'-2&quot; STOCK PASS</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>BARBED WIRE FENCE</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>BRACE PANELS</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>END PANELS</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>CORNER PANELS</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>153</td>
<td>WIRE FENCE GATES</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>TEMPORARY FENCE</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>TRAFFIC CONTROL SIGNS</td>
<td>SF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>156</td>
<td>24' CATTLEGUARD</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>157</td>
<td>30' CATTLEGUARD</td>
<td>EA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>158</td>
<td>GUARDRAIL</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>159</td>
<td>OBLITERATION OF ABANDONED ROADWAYS</td>
<td>ACRE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ITEM NO. 1 - MOBILIZATION

This Bid Item shall include preparatory work and operations including but not limited to those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings, trailers, and other facilities for the work on the project and for all other work and operations which must be performed; and for costs incurred prior to beginning work on the various items on the project.

Payment shall be made under the Lump Sum Bid Item-Mobilization according to the following schedule or as approved by the Owner.

1. 25% of the mobilization pay item price shall be paid with the first payment request.
2. An additional 50% shall be paid when the job is 30% complete based on partial payment without mobilization payments.
3. The final 25% of the pay item shall be paid when the job is 60% complete based on partial payment without mobilization payments.

The Bid Item Mobilization shall have a maximum allowable bid amount of $750,000.

ITEM NO. 2 - TEMPORARY ENVIRONMENTAL PROTECTION MEASURES AT THE DAM SITE AND DIVERSION AND CARE OF DEER CREEK

The Temporary Environmental Protection Measures at the Dam Site and Diversion and Care of Deer Creek shall be paid for by Force Account. Payment shall be made on a cost of the work basis for equipment, material, and labor. This item shall include all temporary environmental protection measures carried out in the immediate dam construction area, including the inundated reservoir area, and all areas upstream of the dam construction area that are used by the Contractor. This item shall include but is not limited to; temporary cofferdams, dikes, bridges, straw bales, sedimentation control fabric, conduits, culverts, levee banks, flumes, channels, drains, pumps, settling ponds, and any other temporary measures necessary to maintain specified water quality standards. This item also includes all water quality monitoring, testing and; reporting; all work required to effect the diversion, maintain the required streamflows, maintain the required water quality standards, divert and/or regulate the streamflows through the 2-24" diameter steel pipes; and all care and diversion of the stream during tunnel closure operations and until the water surface level exceeds Elevation 6500 and all streamflows are able to be passed through the completed Outlet Works. This item includes furnishing, installing, and maintaining the temporary log boom and/or trashrack placed upstream of the diversion tunnel inlet portal. This item includes removal and disposal of the downstream cofferdam, reclamation of Deer Creek from the diversion tunnel outlet portal upstream to and including the stream bed adjacent to the control building, and placing
rockfill to prevent access to the diversion tunnel outlet portal. The item shall include full compensation for all materials, tools, labor, and incidentals necessary to complete the item in accordance with the Drawings and the Specifications. This Bid Item does not include compensation to Contractor for any legal fees, damages, or penalties resulting from water quality violations. The Bid Item shall have a maximum allowable bid amount of $500,000.

**ITEM NO. 3 - CLEARING**

This Bid Item shall include all labor, material, and equipment required for clearing, removing, and disposing of all trees, shrubs, and debris within the limits of the permanent construction area for the dam site, spillway, outlet works, permanent access roads, cofferdam sites, boat ramp, borrow areas, stockpile areas, waste areas, and between the dam site and the spillway. This Bid Item shall also include all labor, material, and equipment required for clearing, removing, and disposing of all trees, shrubs, man made structures, and debris within the reservoir below Elevation 6703 that is not included in any of the above areas.

Payment shall be made at the Unit Price per Acre for all the areas measured along the ground as shown on the Drawings or as directed by the Owner that are acceptably cleared in accordance with the Specifications. The Unit Price per Acre shall be full compensation for this work.

**ITEM NO. 4 - GRUBBING**

This Bid Item shall include all labor, material, and equipment required for grubbing, removing, and disposing of all stumps, roots, brush, organic matter, and other protruding obstructions within the permanent construction areas for the dam site, spillway, outlet works, permanent access roads, cofferdam sites, boat ramp, borrow areas, and stockpile areas.

This Bid Item shall also include the preservation of trees, brush, and vegetation and restoration of damage.

Payment shall be made at the Unit Price per Acre for the areas measured along the ground as shown on the Drawings or as directed by the Owner that are acceptably grubbed in accordance with the Specifications. The Unit Price per Acre shall be full compensation for this work.

**ITEM NO. 5 - STEEL PIPE 24-INCH**

The 24-inch diameter steel pipe shall be measured and paid for at the Unit Price per Linear Foot as installed and accepted in the Diversion Tunnel. The Unit Price shall be full compensation for all materials; including fittings, supports, couplings, and appurtenances; tools; labor; all testing; and all incidentals necessary to complete the Item in accordance with the Drawings and Specifications.
ITEM NO. 6 - GATE VALVE 24-INCH

The 24-inch gate valve with manual operator shall be measured and paid for at the Unit Price for Each as installed and accepted in the Diversion Tunnel. The Unit Price shall be full compensation for all materials, tools, labor, testing, and all incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

ITEM NO. 7 - UPSTREAM COFFERDAM OUTLET WORKS

This Bid Item shall consist of furnishing and delivering the culvert, cutoff collars, coupling bands, gaskets, control device, control stem, handwheel, control stem supports, and all incidentals; for furnishing all labor, tools, and equipment for the installation of the culvert, cutoff collars, coupling bands, gaskets, control device, control stem, handwheel, incidentals, and control stem supports; for all testing; and for all labor and material required to excavate for, to form, and to place all concrete pads and encasements required to complete this work in accordance with the Drawings and Specifications.

Payment shall be made at the Lump Sum Price for Upstream Cofferdam Outlet Works installed. The Lump Sum Price shall be full compensation for this work.

ITEM NO. 8 - DOWNSTREAM COFFERDAM OUTLET WORKS

This Bid Item shall consist of furnishing and delivering the pipe, connections, connecting hardware, trash racks, control device, control stem, handwheel, control stem supports, and all incidentals; for furnishing all labor, tools, and equipment for the installation of the pipe, connections, connecting hardware, trash racks, control device, control stem, handwheel, incidentals, and control stem supports; for all testing; and for all labor and material required to excavate for, to form, and to place all concrete pads and encasements required to complete this work in accordance with the Drawings and Specifications.

Payment shall be made at the Lump Sum Price for Downstream Cofferdam Outlet Works installed. The Lump Sum Price shall be full compensation for this work.

ITEM NO. 9 - DESIGNATED HAUL ROAD MAINTENANCE

This Bid Item shall consist of providing all labor, materials, water, and equipment to maintain the designated haul road in accordance with the Specifications and as directed by the Owner. This Bid Item shall include routine maintenance during construction seasons, snow removal as directed by the Owner during construction seasons, and final restoration as directed by the Owner.

Payment for this Bid Item shall be made at an authorized cost plus time and material Force Account.
This Bid Item—Designated Haul Road Maintenance shall have a maximum allowable bid amount of $800,000.

**ITEM NO. 20 - EXCAVATION, TUNNEL AND SHAFT**

This Bid Item shall include all labor, materials, and equipment and performing all operations required to be performed to excavate the Diversion Tunnel between Station 0+00 and 5+17.46 and between Station 12+75.45 and 20+34.21, Outlet Works Shaft—Station 0+00 Shaft Elevation 6496.00 to Elevation 6456.30, Outlet Works Tunnel—Station 0+00 to 10+06.85; for constructing, maintaining, and obliterating temporary access and haul roads to the portals; for temporary dewatering, heating, ventilation, and lighting; for removal of all temporary dewatering, heating, ventilation, and lighting; for furnishing and installing all steel sets, including wood foot block, foot plate, wall plate, tie rods, wood blocking, and channel lagging; for all testing; and for furnishing and installing all tunnel safety measures and tunnel portal protection. This Bid Item shall also include all labor, materials, and equipment required and performing all operations required to be performed to haul all excavated materials to stockpiles or waste areas; to maintain the Diversion Tunnel, Outlet Works Shaft, Outlet Works Tunnel, and tunnel portal protection; to maintain the temporary dewatering, heating, ventilation, and lighting, and to maintain all steel sets, wood foot blocks, foot plates, wall plates, tie rods, wood blocking, and channel lagging.

Payment for this Bid Item shall be made at the Unit Price per Linear Foot as measured along the centerline of the tunnel and excavated to the Design lines plus the amount of excavation as determined by the Contractor outside the Design lines necessary to allow installation of tunnel and shaft supports. The Unit Price per Linear Foot shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Any additional sets, rock bolts, and/or shotcrete required in the Outlet Works and/or Diversion Tunnels shall be paid for under separate Bid Items.

**ITEM NO. 21 - TUNNEL SETS, CIRCULAR**

Circular Tunnel Sets required, as determined by the Owner, in excess of those as shown on the Drawings for the Outlet Works Station 0+00 shaft, Elevation 6495.50 to Elevation 6454.30, shall be measured and paid for at the Unit Price per Each as installed and accepted in the Outlet Works Shaft. The Unit Price shall include furnishing and installing the circular tunnel sets including wall plates, tie rods, wood blocking, and channel lagging. The Unit Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

**ITEM NO. 22 - TUNNEL SETS, STANDARD MODIFIED HORSESHOE**

Standard Modified Horseshoe sets required, as determined by the Owner, in excess of those as shown on the Drawings for the Diversion Tunnel Station 0+00 to Station 4+74.00, Diversion Tunnel Station 12+90.00 to Station
20+34.21, Outlet Works Tunnel Station 0+07 to Station 1+12.27, and Outlet Works Tunnel Station 8+70.93 to Station 10+06.85; shall be measured and paid for at the Unit Price per Each as installed and accepted in the Tunnel. The Unit Price shall include furnishing and installing the steel sets including grout cushion, wood foot block, foot plate, wall plate, tie rods, wood blocking, and channel lagging. The Unit Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

ITEM NO. 23 - TUNNEL SETS, EXTENDED MODIFIED HORSESHOE

Extended Modified Horseshoe sets required, as determined by the Owner, in excess of those as shown on the Drawings for the Diversion Tunnel Station 4+74.00 to Station 12+90.00 shall be measured and paid for at the Unit Price per Each as installed and accepted in the Tunnel. The Unit Price shall include furnishing and installing the steel sets including grout cushion, wood foot block, foot plate, wall plate, tie rods, wood blocking, and channel lagging. The Unit Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

ITEM NO. 24 - EXCAVATION, COMMON

This Bid Item shall include all labor, materials, and equipment and performing all operations required to be performed for open-cut excavation for the dam foundation, plinth, intake structure of the outlet works, control building of the outlet works, spillway, cofferdams, and other miscellaneous construction features to the lines, grades, and dimensions as shown on the Drawings. This Bid Item shall also include all labor, materials, and equipment required to clean the excavated surfaces of the dam foundation, plinth, intake structure of the outlet works, control building of the outlet works, spillway, and cofferdams; to segregate materials by loads; to drain or dry otherwise suitable material; to haul all excavated material from the excavation to temporary stockpiles or waste areas; to re-handle excavated materials which have been deposited in temporary stockpiles; and to shape excavated materials within the waste areas.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for areas excavated in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Common excavation material removed from borrow areas and rock quarries shall be subsidiary to the appropriate Fill Placement Bid Item.

ITEM NO. 25 - EXCAVATION, ROCK

This Bid Item shall include all labor, materials, and equipment and performing all operations required to be performed for open-cut excavation of the dam foundation, plinth, intake structure of the outlet works, control building of the outlet works, spillway, other miscellaneous facilities,
trenches, pits, and footings to the lines, grades, and dimensions as shown on the Drawings. This Bid Item also includes all labor, materials, and equipment for blasting; to clean the excavated surfaces of the dam foundation, plinth, intake structure of the outlet works, control building of the outlet works, spillway, other miscellaneous facilities, trenches, pits, and footings; to segregate material by loads; to drain or dry otherwise suitable material; to haul all excavated material from the excavation to temporary stockpiles or waste areas; to re-handle excavated materials which have been deposited in temporary stockpiles; and to shape excavated materials within the waste areas.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for areas excavated in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Rock excavation material removed from quarry areas shall be subsidiary to the appropriate Fill Placement or Concrete Bid Item.

ITEM NO. 26 - FILL PLACEMENT, ZONE 1

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construction the dam Zone 1 embankments. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to strip and work the borrow areas; to construct, maintain, and obliterate temporary haul roads; to haul the material from the borrow areas to the embankments; to place and compact the material; to haul and apply water to the material; to moisten and scarify the material where necessary; to handle, process, and dry otherwise suitable material; and for final clean up of fill placement and borrow areas in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

ITEM NO. 27 - FILL PLACEMENT ZONE 2

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the dam Zone 2 embankment and backfill. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to construct, maintain, and obliterate temporary haul roads; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the processing plant, dam embankment, or backfill area; to strip, blast, and otherwise work the rock quarries; to process, handle, load, and to haul material from the processing plant to the dam embankment or backfill area; to place and compact the material; to furnish and apply water and for final clean up in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings and within the
tolerances listed in the Specifications or where directed by the Owner.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Filling irregularities, fissures, or open joints below the general level of the dam embankment foundation or modifying abutment contact slopes shall be paid for under Bid Item-Concrete, Class C.

ITEM NO. 28 - FILL PLACEMENT ZONE 2A

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the dam Zone 2A embankment and backfill. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to construct, maintain, and obliterate temporary haul roads; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the processing plant, dam embankment, or backfill area; to strip, blast, and otherwise work the rock quarries; to process, handle, load, and to haul material from the processing plant to the dam embankment or backfill area; to place and compact the material; to furnish and apply water and for final clean up in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings and within the tolerances listed in the Specifications or where directed by the Owner.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Filling irregularities, fissures, or open joints below the general level of the dam embankment foundation or modifying abutment contact slopes shall be paid for under Bid Item-Concrete, Class C.

ITEM NO. 29 - FILL PLACEMENT ZONE 3A

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the dam Zone 3A embankment. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to construct, maintain, and obliterate temporary haul roads; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the dam embankment; to strip, blast, and otherwise work the rock quarries; to place and compact the material; to furnish and apply water and for final clean up of fill placement and rock quarries in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings and within the tolerances listed in the Specifications.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for
fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Filling irregularities, fissures, or open joints below the general level of the dam embankment foundation or modifying abutment contact slopes shall be paid for under Bid Item-Concrete, Class C.

ITEM NO. 30 - FILL PLACEMENT ZONE 3B

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the dam Zone 3B embankment. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to construct, maintain, and obliterate temporary haul roads; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the dam embankment; to strip, blast, and otherwise work the rock quarries; to place and compact the material; to furnish and apply water and for final clean up of fill placement and rock quarries in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings and within the tolerances listed in the Specifications.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

Filling irregularities, fissures, or open joints below the general level of the dam embankment foundation or modifying abutment contact slopes shall be paid for under Bid Item-Concrete, Class C.

ITEM NO. 31 - FILL PLACEMENT ZONE 4

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the dam Zone 4 embankments. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the embankment; to strip and work the borrow areas and haul the material from the borrow areas to the embankments; to haul the material from required excavations or temporary stockpiles to the embankments; to construct, maintain, and obliterate temporary haul roads; to place and compact the material; to haul and apply water to the material; to moisten and scarify the material where necessary; to handle, process, and dry otherwise suitable material; and for final clean up of fill placement and borrow areas in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for fill placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.
ITEM NO. 32 - FILL PLACEMENT, ZONE 5

This Bid Item shall be identical to Bid Item No. 26-Fill Placement, Zone 1 or to Bid Item No. 31-Fill Placement, Zone 4 at the Contractor's option.

ITEM NO. 33 - DRAINAGE BLANKET

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to construct the drainage blanket. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam foundation surfaces to receive the material; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the processing plant or dam embankment; to strip, blast, and otherwise work the rock quarries; to process, handle, load and to haul material from the processing plant to the dam embankment; to place and compact the material; to furnish and apply water; and for final clean up of fill placement and rock quarries in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for material placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

ITEM NO. 34 - RIPRAP

This Bid Item shall include all labor, materials, water, and equipment and performing all operations required to be performed to place the riprap on the cofferdam embankments. This Bid Item also includes all labor, materials, and equipment to clean and prepare dam embankment surfaces to receive the material; to load and haul the material from required excavation sources, rock quarries, or temporary stockpiles to the dam embankment; to strip, blast, and otherwise work the rock quarries; to place the material; and for final clean up in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings.

Payment for this Bid Item shall be made at the Unit Price per Cubic Yard for riprap placed in accordance with the Drawings and Specifications. The Unit Price per Cubic Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

ITEM NO. 35 - COMPACTION AND SEALING OF DAM EMBANKMENT UPSTREAM FACE

This Bid Item shall include all labor, materials, and equipment and performing all operations required to be performed to compact and seal the upstream face of the dam embankment. This Bid Item shall also include all labor, materials, and equipment to clean, prepare, compact, and to trim the upstream face; to load and haul the trim material and seal coat aggregate from required excavation sources, rock quarries, or temporary stockpiles to the processing plant or dam embankment; to process, handle, load and haul trim material and seal coat aggregate from the processing plant to the dam
embankment; to place and compact the trim material and seal coat aggregate; to furnish and apply the cationic bituminous emulsion coats; to furnish and mix the water with the emulsion; to clean the excess seal aggregate material from the upstream face; to place and compact a second seal coat of cationic bituminous emulsion and seal aggregate material; and for final clean up in accordance with the Specifications and to the lines, grades, and dimensions shown on the Drawings.

Payment for this Bid Item shall be made at the Unit Price per Square Yard of upstream face of dam embankment compaction and sealing done in accordance with the Drawings and Specifications. The Unit Price per Square Yard shall be full compensation for this work acceptably completed in accordance with the Drawings and Specifications.

ITEM NO. 36 - EMERGENCY ACCESS TRAIL

This Bid Item shall consist of providing all labor, material, equipment, and of performing all operations required to be performed to grade the Emergency Access Trail; for disposal of all undesirable and waste materials; to place crushed aggregate surface course; and to install water bars in the trail in accordance with the Drawings and Specifications. This Bid Item shall also include hauling the undesirable and waste materials from the construction area to the waste area and hauling the crushed aggregate surface course from the quarry or stockpile to the place of final use.

Payment shall be made at the Lump Sum Price for Emergency Access Trail as shown on the Drawings or directed by the Owner and as completed in accordance with the Specifications. The Lump Sum Price shall be full compensation for this work.

ITEM NO. 37 - REVEGETATION OF DAM AREA

This Bid Item shall consist of providing all labor, water, material, and equipment and performing all operations required for depositing topsoil, for seed bed preparation, seeding, mulching, fertilizing, and installing excelsoir matting in disturbed areas within the dam area in accordance with the Drawings and Specifications.

Payment shall be made at the Unit Price per Acre for the areas measured along the ground as shown on the Drawings or as directed by the Owner that are acceptably revegetated in accordance with the Specifications. The Unit Price per Acre shall be full compensation for this work.

ITEM NO. 50 - STANDPIPES AND FITTINGS FOR PRESSURE GROUTING

The standpipes and fittings required for pressure grouting shall be measured and paid for at the Unit Price per Each for each accepted installation. Each standpipe together with its associated fittings shall constitute one installation.

The Unit Price shall be full compensation for supplying and placing metal
pipe and fittings for pressure grouting. This Unit Price shall include the cost of supplying, unloading, hauling, storing, handling; installing and removing the pipe and fittings, set-up and drilling the installation hole, of protecting the pipe from injury and clogging, and of sealing the hole after grouting. This Unit Price shall include cement for installation of standpipes and cement used for backfill grout when pressure grouting is completed. This Unit Price shall also include tools, labor, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications.

This Unit Price does not include any pipes and fittings or the sealing of the holes at the completion of pressure grouting necessary for crown, tunnel plug, or interface grouting. These pipes and fittings and the cost of sealing the holes shall be included in other Bid Items.

ITEM NO. 51 - HOOK-UP TO GROUT HOLES AND CONNECTIONS

Hook-ups for pressure grouting shall be measured and paid for at the Unit Price per Each for each accepted hook-up. Payment shall be made only once for each application of grout to each stage of each grout hole or connection and shall include the cost of connecting water testing equipment when directed by the Owner.

The Unit Price shall be full compensation for all materials, tools, labor, water testing, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications.

ITEM NO. 52 - DRILL RIG SET-UP

Drill rig set-up required for drilling pressure grout holes shall be measured and paid for at the Unit Price per Each for each accepted drill rig set-up. Payment for drill rig set-up shall be made each time a drill rig is set up over a hole location at the instruction of the Owner, provided that set-up is not required to correct a problem caused by the Contractor.

The Unit Price shall be full compensation for all equipment, materials, tools, labor, installation and removal of all drill rig supports, construction and removal of scaffolding and other temporary structures needed to access the holes, all safety measures, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications.

Payment under this Bid Item shall not be made for drill rig set-up to install standpipes and fittings. These drill rig set-ups shall be included in the Unit Price for Standpipe and Fittings.

ITEM NO. 53,54,55,56,57,58,59,60,61,& 62 - DRILLING PRESSURE GROUT HOLES

The drilling and washing of the holes required for pressure grouting shall be paid for at the Unit Price per Linear Foot. Different rates shall be applied for different depths of holes drilled between 0 to 40 feet, between 40 to 80 feet, between 80 to 130 feet, between 130 to 180 feet, and between 180 to 250
feet. Separate rates shall be applied for drilling consolidation and curtain holes at the plinth and in the tunnel, and separate rates shall be applied for drilling curtain holes at the spillway and for miscellaneous grout holes. No differentiation in rates shall be made for different materials drilled through.

Measurement, for payment of those holes which have been drilled for pressure grouting shall be made at the time of pressure grouting and only the length of holes actually drilled, washed, and pressure grouted, or redrilled, washed, and pressure grouted at the direction of the Owner shall be considered for payment. Holes which cannot be used because of: 1) incorrect location by the Contractor; 2) abandonment due to loss of drilling or grouting equipment down the hole; 3) abandonment due to the Contractor’s inability to provide the required depth; or 4) because of cave-ins before grouting shall not be measured for payment. Measurement of the hole depth shall commence from the bottom of the standpipe or the surface of the rock or concrete if standpipes are not used. The length of each hole shall be taken as the total length of the hole drilled through concrete and rock provided that the bottom level of the hole is not lower than that level directed by the Owner.

Progress payments shall be made for the actual footage drilled at the Unit Price per Linear Foot. No adjustments in Unit Prices per Linear Foot shall be made for overrun or underrun of the Owner’s original estimate of the amount of drilling.

The Unit Price per Linear Foot shall be full compensation for supplying all labor, materials, equipment, tools, washing the holes, all safety measures, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications.

Payment under this Bid Item shall not be made for drilling crown and interface grout holes in the tunnel and shaft. Drilling crown and interface grout holes shall be included under other Bid Items. Payment under this Bid Item shall not be made for drilling holes for standpipe installation. Drilling holes for standpipe installation shall be included in the Unit Price for Standpipes and Fittings.

**ITEM NO. 63 - PRESSURE GROUTING**

Curtain, consolidation, and miscellaneous pressure grouting shall be measured and paid for based on the number of sacks of cement actually injected into the holes, grout connections, or required to fill permanent pipes and shall include 50 percent of the Owner’s estimate of line waste. One sack of cement shall be considered as 94 pounds.

The quantity of curtain, consolidation, and miscellaneous grouting which shall be required is uncertain and cannot be accurately estimated. Accordingly, the quantity stated in the Bid Schedule is solely for the purpose of comparison of bids, and the actual quantity may vary widely therefrom. Since the quantity of curtain, consolidation, and miscellaneous grouting is uncertain, payment shall be made in accordance with the following formula:

BI-12
a. If the final grouting quantity averages less than 0.50 sacks of cement per linear foot of drilled grout hole, payment shall be made at the Unit Price per Sack stated in the Bid Schedule for Pressure Grouting for the sacks of cement actually placed, plus an allowance of 75 percent of the Unit Price per Sack for Pressure Grouting for the additional sacks of cement required to average 0.50 sacks of cement per linear foot of drilled grout hole.

b. The final grouting quantity averages between 0.50 sacks and 1.50 sacks of cement per linear foot of drilled grout hole, payment shall be made at the Unit Price per Sack in the Bid Schedule for Pressure Grouting.

c. If the final grouting quantity exceeds an average of 1.50 sacks of cement per linear foot of drilled grout hole, payment shall be made at the Unit Price per Sack stated in the Bid Schedule for Pressure Grouting for the amount required to average 1.50 sacks per linear foot of drilled hole, and all grouting in excess of the 1.50 average shall be paid for at 50 percent of the Unit Price per Sack stated in the Bid Schedule for Pressure Grouting.

Progress payments shall be made for the sacks of cement actually placed at the Unit Price per Sack for Pressure Grouting. Upon completion of the grouting operation, the average sacks of cement per linear foot of hole shall be determined by dividing the total sacks of cement actually placed, and for which progress payments for grouting was made, by the total linear feet of drilled holes actually drilled, and excluding any redrill unless approved by the Owner. Any adjustment under (a) and (c) above shall then be made. Except as otherwise provided herein, the Contractor shall be entitled to no extra compensation above the Unit Price per Sack by reason of increased or decreased quantity of grouting.

Except as otherwise provided below, the Unit Price per Sack in accordance with the formula shall be full compensation for furnishing all labor, water, caulking, bentonite, and other materials; all equipment, tools and incidentals needed for curtain, consolidation, and miscellaneous grouting in accordance with the Drawings and Specifications. The Unit Price per Sack shall include communication facilities required for the grouting, plugging and caulking leaks, using packers, providing cement and bentonite samples, protection of the permanent structures, care of wastewater and grout, and clean up.

Payment for furnishing, handling, storing, transporting and using bentonite shall be made for the quantities actually used in grout and shall be made at the invoice cost plus 15%.

No payment shall be made for grout, or for cement, or for bentonite lost due to improper anchorage of grout pipes or connections, and for grout, cement, or bentonite rejected by the Owner on account of improper mixing, or lost by leakage due to the failure of the Contractor to caulk leaks when directed by the Owner.

Payment under this Bid Item shall not be made for pressure grouting the crown holes and interface holes in the tunnel and shaft or for grouting the crown
through pipes in the tunnel plugs. Pressure grouting the crown holes, interface holes, and the tunnel plugs shall be included in other Bid Items. Payment for hooking onto each grout hole or grout connection, payment for standpipes and fittings, payment for furnishing and handling cement for pressure grouting shall be included in other Bid Items.

ITEM NO. 64 - FURNISHING AND HANDLING CEMENT FOR PRESSURE GROUTING

Furnishing and handling cement for pressure grouting shall be measured and paid for at the Unit Price per Sack. Payment shall be made for the actual sacks of cement used in grout. No adjustments in the Unit Price per Sack shall be made for overrun or underrun of the Owner’s original estimate of the amount of cement.

The Unit Price per Sack shall be full compensation for all costs of storing, handling, supplying, and transporting cement for pressure grouting.

Payment under this Bid Item shall not be made for furnishing and handling cement for crown grouting and interface grouting in the tunnel and shaft or for crown grouting in the tunnel plugs. Furnishing and handling cement for crown grouting, interface grouting and tunnel plug grouting shall be included in other Bid Items.

ITEM NO. 65 - WATER TESTING FOR PRESSURE GROUTING

Water testing required for pressure grouting shall be measured and paid for at the Unit Price per Hour. Measurement shall start at the beginning of the water test at the time water is first injected through the connected water testing equipment and shall stop when the Owner determines the water test is completed. Measurement and payment shall be made to the nearest five minutes.

The Unit Price per Hour shall be full compensation for all equipment, materials, tools, labor, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications.

No measurements for payment shall be made during the time water tests are interrupted because the Contractor has failed to properly connect the testing equipment or due to equipment break down.

Payment under this Bid Item shall not be made for connecting water testing equipment. Connecting water testing equipment shall be included in the Bid Item - Hook-up to Grout Holes and Connections.

ITEM NO. 80 - PLINTH CONCRETE, CLASS B WITH FIBERS

This Bid Item shall include all labor, materials, and equipment required for furnishing, placing, and removing forms, form sealers, bracing, ties, nails, spreaders, and all incidentals; for flushing spreader and sleeve nut holes with water; for grouting spreader and sleeve nut holes; and for furnishing and applying water or form oil to forms before concrete placement. This Bid
Item shall also include all labor, material, and equipment required for furnishing, placing, splicing, and cleaning reinforcing bars; and for furnishing, placing, and cleaning metal chairs, spacers, hangers, and all incidentals. This Bid Item further includes all labor, material, and equipment required for furnishing and mixing cement, fiber reinforcement, water, aggregate, and admixtures; for cleaning surfaces; for furnishing and placing concrete, construction joints, contraction joints, dowels, anchor bolts, stud anchors, expansion anchors, miscellaneous anchors, embedded metal plate assemblies, moldable waterstops, waterstops, stainless steel waterstops, sealants, grout, and incidentals; for finishing; for furnishing and applying curing mists, membranes, and compounds; for furnishing, fabricating, installing, maintaining, and removing the plinth waterstop protection box; for furnishing and mixing water and cement for the mortar pad and for placing the mortar pad in accordance with the Drawings and Specifications.

Payment shall be made at the Unit Price per Cubic Yard to the lines and grades as shown on the Drawings and as completed in accordance with the Specifications. The Unit Price per Cubic Yard shall be full compensation for this work.

Rock anchors shall be paid for under other Bid Items.

ITEM NO. 81 - FACE SLAB CONCRETE, CLASS B WITH FIBERS

This Bid Item shall include all labor, materials, and equipment required for furnishing, placing, and removing forms, form sealers, bracing, ties, nails, and all incidentals; for furnishing, placing, and removing screeding supports; for furnishing and mixing water and grout for grout pads; for placing grout pads; and for furnishing and applying water or form oil to forms before concrete placement. This Bid Item shall also include all labor, material, and equipment required for furnishing, placing, splicing, and cleaning reinforcing bars; and for furnishing, placing, and cleaning metal chairs, spacers, hangers, and all incidentals. This Bid Item further includes all labor, material, and equipment required for furnishing and mixing cement, fiber reinforcement, water, aggregate, and admixtures; for cleaning surfaces; for furnishing and placing concrete, redwood lumber for joints, construction joints, contraction joints, dowels, anchor bolts, stud anchors, expansion anchors, miscellaneous anchors, embedded metal plate assemblies, moldable waterstops, waterstops, stainless steel waterstops, sealants, paint, grout, and incidentals; for screening and finishing; for furnishing and applying curing mists, membranes, and compounds in accordance with the Drawings and Specifications.

Payment shall be made at the Unit Price per Cubic Yard to the lines and grades as shown on the Drawings and as completed in accordance with the Specifications. The Unit Price per Cubic Yard shall be full compensation for this work.
ITEM NO. 82 - CREST WALL CONCRETE, CLASS B WITH FIBERS

This Bid Item shall include all labor, materials, and equipment required for furnishing, placing, and removing forms, form sealers, bracing, ties, nails, spreaders, and all incidentals; for flushing spreader and sleeve nut holes with water; for grouting spreader and sleeve nut holes; and for furnishing and applying water or form oil to forms before concrete placement. This Bid Item shall also include all labor, material, and equipment required for furnishing, placing, splicing, and cleaning reinforcing bars; and for furnishing, placing, and cleaning metal chairs, spacers, hangers, and all incidentals. This Bid Item further includes all labor, material, and equipment required for furnishing and mixing cement, fiber reinforcement, water, aggregate, and admixtures; for cleaning surfaces; for furnishing and placing concrete, form oil, water, construction joints, dowels, anchor bolts, eye bolts, expansion anchors, miscellaneous anchors, embedded metal plate assemblies, moldable waterstops, waterstops, stainless steel waterstops, sealants, grout, and incidentals; for finishing; for furnishing and applying curing mists, membranes, and compounds in accordance with the Drawings and Specifications.

Payment shall be made at the Unit Price per Cubic Yard to the lines and grades as shown on the Drawings or as directed by the Owner and as completed in accordance with the Specifications. The Unit Price per Cubic Yard shall be full compensation for this work.

Rock anchors and crest wall monuments shall be paid for under other Bid Items.

ITEM NO. 83 - CONCRETE, CLASS C

This Bid Item shall include all labor, material, and equipment required for furnishing, placing, and removing forms, form sealers, bracing, ties, nails, and all incidentals; for furnishing and applying water or form oil to forms before concrete placement; for furnishing, placing, splicing, and cleaning reinforcing bars; for furnishing, placing, and cleaning metal chairs, spacers, hangers, and all incidentals; for furnishing and mixing cement, water, aggregate, and admixtures; for cleaning surfaces; for furnishing and placing concrete, construction joints, dowels, and all incidentals; and for furnishing and applying curing mists, membranes, and compounds in accordance with the Drawings and Specifications. This Bid Item also includes all labor, materials, and equipment required to fill irregularities, fissures, or open joints below the general level of the dam embankment foundation or to modify abutment contact slopes.

Payment shall be made at the Unit Price per Cubic Yard to the lines and grades as shown on the Drawings or as directed by the Owner and as completed in accordance with the Specifications. The Unit Price per Cubic Yard shall be full compensation for this work.
ITEM NO. 84 - SHOTCRETE

Shotcrete shall be measured and paid for by the Unit Price per Cubic Yard based on the areas covered and the thickness of the shotcrete layers as applied and accepted by the Owner. The Unit Price per Cubic Yard shall be full compensation for furnishing equipment; including approved mixing and delivery apparatus, preparing shotcrete panels for testing, labor, drilling weep holes where required, furnishing and installing chain link fabric excluding overlap, furnishing and installing all chain link fastening devices, and providing materials and all incidentals necessary to complete the work in accordance with the Drawings and Specifications. Payment for miscellaneous shotcrete applications in permanent rock excavations in excess of those shown on the Drawings shall be made only for applications required and approved by the Owner.

ITEM NO. 85 & 86 - UNTENSIONED ROCK ANCHORS

Untensioned rock anchors shall be measured and paid for at the Unit Price per Linear Foot for each diameter rock anchor as installed and accepted by the Owner. The Unit Price per Linear Foot shall be full compensation for furnishing all equipment; including drills, tools, and test apparatus; materials; including anchor bars and epoxy resin or cement grout ingredients; labor for drilling, installation, grouting, and testing, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications. Payment for rock anchors installed in permanent rock excavations in excess of those shown on the Drawings shall be made only for rock anchors required and accepted by the Owner.

ITEM NO. 87 - ROCK BOLTS, PRETENSIONED

Pretensioned rock bolts shall be measured and paid for at the Unit Price per Linear Foot as installed and accepted by the Owner. The Unit Price per Linear Foot shall be full compensation for furnishing all equipment, including drills, tools, and test apparatus; materials, including rock bolts and accessories, and epoxy resin or cement grout ingredients; labor for drilling, installation, grouting, plugging and caulking of grout leaks, and testing, and all incidentals necessary to complete the work in accordance with the Drawings and Specifications. Payment for rock bolts installed in permanent rock excavations in excess of the rock bolts shown on the Drawings shall be made only for additional rock bolts required and accepted by the Owner.

ITEM NO. 688 - PRE-SUPPORT ROCK DOWELS, UNTENSIONED

Untensioned pre-support rock dowels shall be measured and paid for at the Unit Price per Linear Foot as installed and accepted by the Owner. The Unit Price per Linear Foot shall be full compensation for furnishing all equipment, including drills and tools; materials, including reinforcing steel for dowels and epoxy resin or cement grout ingredients; labor for drilling, installation and grouting; and all incidentals necessary to complete the item in accordance with the Drawings and Specifications. Payment for pre-support
rock dowels in excess of those shown on the Drawings shall be made only for
the additional pre-support rock dowels required and accepted by the Owner.

ITEM NO. 100 - INTAKE STRUCTURE

The Intake Structure shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for Intake Structure. The Lump Sum Price shall include furnishing and installing all concrete, steel reinforcement, trash rack, miscellaneous metal, lifting hooks, water stop, steel liner above Elevation 6495.50, and excavation from bench Elevation 6496.00 to the Intake Structure foundation Elevation 6495.50. The Unit Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

ITEM NO. 101 - TUNNEL LINING

The Tunnel Lining shall be measured along the centerline of the Outlet Works Tunnel and shall be paid for at the Unit Price per Linear Foot. Tunnel Lining shall include the Outlet Works shaft at Station 0+00 from Elevation 6495.50 to Elevation 6456.3 and the Outlet Works Tunnel from Station 0+00 to the tunnel portal at Station 10+06.85. The Unit Price shall include furnishing and installing the 5/8" thick steel liner, steel reinforcement outside of the steel liner, concrete fill outside of the steel liner, drilling and pressure crown grouting, drilling and interface pressure grouting, and pressure crown grouting for the concrete tunnel plugs. The Unit Price shall include all concrete outside of the steel liner in the tunnel closure areas including the tunnel plug concrete. The Unit Price shall also include all rock bolts, chain link fabric, and shotcrete as specified in the shaft/tunnel intersection area and in the tunnel closure area. The Unit Price shall also include fabrication, installation, and removal of the temporary waterproof bulkheads in the tunnel closure areas. The Unit Price shall include complete installation of all level sensing lines. (Note that the level sensing lines extend outside of the limits of the actual tunnel from the control building to the intake structure and up the concrete face of the embankment to Elevation 6648.00.) The Unit Price shall also include all welding, radiographic inspection, field preparation, interior coating, and hydrostatic testing of the installed lining. The Unit Price shall be full compensation for all materials, tools, labor, testing, and all incidentals necessary to complete the item in accordance with the Drawings and the Specifications.

The tunnel curtain grouting, and drilling and pressure grouting miscellaneous holes for faults, joints, shear zones, springs, and other rock defects shall be paid for under Bid Items.

ITEM NO. 102 - CONTROL BUILDING

The Control Building shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for Control Building. The Lump Sum Price shall include furnishing and installing all concrete, concrete reinforcement, steel pipe, steel pipe reinforcement, fittings, transitions, wye branches,
welding, radiographic inspection, interface grouting, field preparation, interior coating, and hydrostatic testing of the steel pipe from Outlet Works Tunnel Portal Station 10+06.85 to and including the entire Control Building. The Lump Sum Price shall include furnishing and installing the 12-inch diameter pipe at Outlet Works Station 10+24.85, Station 10+29.85, and Station 10+34.85. The Lump Sum Price shall include heating and dehumidification systems, electrical system, bridge crane system, roofing, insulation, metal grating, doors, and all incidentals and appurtenances; furnishing and installing the exterior retaining walls adjacent to the control building; furnishing and installing the Conveyance System for transporting materials and equipment from the interior of the control building to the exterior concrete slab area; and all shop and field testing of all materials and systems as required in the Specifications. The Lump Sum Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

Excavation, stripping, site grading, structural backfill, and fill placement from the Tunnel Portal Station 10+06.85 to and including the area around the control building shall be paid for under separate Bid Items. The Telemetry, Instrumentation, and Control System shall be paid under a separate Bid Item. All Class C concrete below Elevation 6443.00 shall be paid under a separate Bid Item.

ITEM NO. 103 - STAND-BY POWER BUILDING

The Stand-by Power Building shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for Stand-by Power Building. The Lump Sum Price shall include furnishing and installing all concrete, masonry units, concrete and masonry reinforcements, insulation, roofing, doors, stand-by generator and engine, transfer switch, batteries, ductwork, mechanical system, electrical system, and all incidentals included in the entire Stand-by Power Building; furnishing and installing all service entrance equipment and all service drop equipment, including metering and transformer; furnishing and installing the primary line extension from the northeast side of the spillway (the end point of the primary line as installed by the Utility Company) to the transformer and secondary power to the Stand-by Power Building and the service from the Stand-by Power Building to the Control Building; and furnishing and installing the stand-by power fuel tank. The Lump Sum Price shall be full compensation for all materials, tools, labor, appurtenances, and incidentals necessary to complete the item in accordance with the Drawings and Specifications.

Excavation, stripping, site grading, and structural backfill for the Stand-by Power Building and surrounding area and furnishing and installing the chain link security fence enclosing the stand-by power building and surrounding area shall be paid for under separate Bid Items.

ITEM NO. 104 - SPILLWAY

This Bid Item shall include all labor, materials, and equipment to construct the concrete spillway structure, concrete bridge with guardrail, and concrete stilling basin. This Bid Item shall include all labor, materials, and
equipment required for furnishing, placing and removing forms, form sealers, bracing, ties, nails, spreaders, and all incidentals; for flushing spreader and sleeve nut holes with water, for grouting spreader and sleeve nut holes; for furnishing and applying water or form oil to forms before concrete placement; for furnishing, placing, splicing, and cleaning reinforcing bars; for furnishing, placing and cleaning metal chairs, spacers, hangers, and all incidentals; for furnishing and mixing cement, water, aggregate, and admixtures; for cleaning surfaces; for furnishing and placing concrete, construction joints, contraction joints, dowels, anchor bolts, stud anchors, expansion anchors, miscellaneous anchors, embedded metal plate assemblies, moldable waterstops, waterstops, sealants, grout, and incidentals; for finishing; and for furnishing and applying curing mists, membranes, and compounds. This Bid Item also includes all labor, materials, and equipment required to furnish and install bridge guardrail with posts, anchor bolts with nuts, toggle bolts with nuts and pins, concrete anchorage hardware, grout, and all incidentals. This Bid Item further includes all labor, materials, and equipment and performing all operations required to be performed to drill the weep holes in the spillway structure, to drill the drain holes in the stilling basin, and to furnish and install PVC underdrains in accordance with the Drawings and Specifications.

Payment shall be made at the Lump Sum Price for the Spillway acceptably constructed in accordance with the Drawings and Specifications. The Lump Sum Price shall be full compensation for this work.

Rock anchors and crushed aggregate surface course shall be paid for under other Bid Items.

ITEM NO. 105 - GONDOLA SYSTEM

This Bid Item shall include all labor, materials, and equipment to design and construct an aerial gondola system. This Bid Item shall include all cables, foundation concrete, cable hardware, sheaves, rollers, gondolas, support structures, foundation excavation, form work, backfill, all controls, control wiring, prime mover, all speed reducers and gearing, all brakes, overspeed devices, counterweight system, all manual and automatic stop devices, lightning protection, emergency evacuation equipment, equipment buildings, all wiring and conduits, motor starter, disconnect, all trenching and backfill, all testing, and all incidentals required to complete the work in accordance with the Drawings and Specifications.

Payment shall be made at the Lump Sum Price for the Gondola System installed. The Lump Sum Price shall be full compensation for this work.

ITEM NO. 106 - BOAT RAMP

The boat ramp shall be measured and paid for at the Lump Sum Price for the installed and accepted boat ramp. The Lump Sum Price shall be full compensation for labor, equipment, materials, and furnishing and installing the granular bedding, reinforced concrete boat ramp, elevation markers, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

BI-20
Site grading for the ramp shall not be included in the Lump Sum Price but shall be measured and paid for separately for the type of materials excavated. Site grading, crushed aggregate surface course, and guardrail for the boat ramp parking lot, link road and circular boat ramp pad shall not be included in the Lump Sum Price but shall be measured and paid for under other Bid Items.

ITEM NO. 107 - CHAIN LINK FENCE

This Bid Item shall include all labor, materials, and equipment to construct chain link security fence, chain link gates, and an access control gate. This Bid Item shall include all labor, materials, and equipment required to furnish and install chain link fabric, corner posts, end posts, pull posts, line posts, all post tops, all support arms, barbed wire, top rail, sleeve couplers, expansion/contraction couplers, all end clamps, all brace rails, all corner clamps, stretcher bars, stretcher bar bands, tension wire, all fittings, hardware, and all warning signs; to furnish and install all chain link gates with chain link fabric, end posts, post tops, top and bottom rails, end clamps, brace rails, stretcher bars, stretcher bar bands, all fittings and hardware; and to furnish and install an access control gate with posts and all fittings and hardware. This Bid Item shall also include all labor, materials, and equipment required to excavate for all posts; to haul all excavated materials to waste areas; to furnish, place, and tamp concrete for setting posts; and to set posts in concrete structures in accordance with the Drawings and Specifications.

Payment shall be made at the Unit Price per Linear Foot of Chain Link Fence acceptably constructed in accordance with the Drawings and Specifications. The Unit Price per Linear Foot shall be full compensation for this work.

ITEM NO. 108 - DAM INSTRUMENTATION

This Bid Item shall include all labor, materials, and equipment required to furnish, install and maintain during construction crest wall monuments and dam embankment monuments. This Bid Item shall also include all labor, materials, and equipment required to furnish and deliver all brass caps, all rivets, all brass caps with barbs, all galvanized pipes with flared ends, all reinforcing, and concrete; to rivet the brass caps to the galvanized pipe; to clean, tie, and place reinforcing; to excavate for, to form, and to place concrete pedestals; to install the galvanized pipes with riveted brass caps in the concrete pedestals; and to install the barbed brass caps in the crest wall in accordance with the Drawings and Specifications.

Payment shall be made at the Lump Sum Price for Dam Instrumentation acceptably installed. The Lump Sum Price shall be full compensation for this work.
ITEM NO. 109 - TELEMETRY, INSTRUMENTATION, AND CONTROL

Telemetry, Instrumentation and Control shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for Telemetry, Instrumentation, and Control. The Lump Sum Price shall include the hardware and software required for the micro-computer based supervisory control and data acquisition system, communication devices including FM radio transceivers and antennas, remote terminal units and control panels, reservoir level monitoring system, flow transmitters, intrusion alarm systems, stream gauge transmitter and solar photovoltaic system. The Lump Sum Price shall include system factory and field tests and user operation and maintenance training. The Lump Sum Price shall be full compensation for all materials, tools, labor, and incidentals necessary to complete the Item in accordance with the Drawings and Specifications.

ITEM NO. 110 - DUCK CREEK GAGING STATION

The Duck Creek Gaging Station shall be measured as a complete item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of Duck Creek during construction; furnishing and installing the CMP shelter, CMP stilling well, concrete base, piping, valves, water level recorder, and appurtenances; furnishing and installing the parshall flume; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; revegatation of disturbed areas; and channel modification. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 111 - DAVIS CREEK GAGING STATION

The Davis Creek Gaging Station shall be measured as a complete item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of Davis Creek during construction; furnishing and installing the CMP shelter, CMP stilling well, concrete base, piping, valves, water level recorder, and appurtenances; furnishing and installing the parshall flume; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; revegatation of disturbed areas; and channel modification. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 112 - DEER CREEK ABOVE RESERVOIR GAGING STATION

The Deer Creek Above Reservoir Gaging Station shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for the installed
and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of Deer Creek during construction; furnishing and installing the CMU shelter, concrete stilling well and base, piping, valves, water level recorder, and appurtenances; furnishing and installing the cableway and appurtenances; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; and revegetation of disturbed areas. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 113 - WEST FORK DEER CREEK GAGING STATION

The West Fork Deer Creek Gaging Station shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of West Fork Deer Creek during construction; furnishing and installing the CMU shelter, concrete stilling well and base, piping, valves, water level recorder, and appurtenances; furnishing and installing the concrete control structure, riprap, and gabions; furnishing and installing the cableway and appurtenances; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; revegetation of disturbed areas; and channel modification. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 114 - DEER CREEK IN CANYON GAGING STATION

The Deer Creek in Canyon Gaging Station shall be measured as a complete Item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of Deer Creek during construction; furnishing and installing the CMU shelter, concrete stilling well and base, piping, valves, water level recorder, and appurtenances; furnishing 2 staff gages; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; and revegetation of disturbed areas. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 115 - KING CREEK GAGING STATION

The King Creek Gaging Station shall be measured as a complete item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include haul road or trail construction to the site and diversion and care of King Creek during construction; furnishing and installing the CMU shelter, concrete stilling well and base, piping, valves, water level recorder, and appurtenances; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; and revegetation of disturbed areas. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.
construction; furnishing and installing the CMP shelter, CMP stilling well, concrete base, piping, valves, water level recorder, and appurtenances; furnishing and installing the parshall flume; furnishing one staff gage; obliteration of temporary haul roads or trails, unless directed otherwise by the Owner; revegetation of disturbed areas; channel modification; and riprap. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 116 - DEER CREEK IN GLENROCK GAGING STATION

The Deer Creek in Glenrock Gaging Station shall be measured as a complete item of work and shall be paid for at the Lump Sum Price for the installed and accepted gaging station. The Lump Sum Price shall include diversion and care of Deer Creek during construction; furnishing and installing the CMU shelter, concrete stilling well and base, piping, valves, water level recorder, electrical hook-up and service, and appurtenances; furnishing and installing the concrete control structure, riprap, and gabions; furnishing and installing the cableway and appurtenances; revegetation of disturbed areas and channel modification. The Lump Sum Price shall be full compensation for labor, equipment, furnishing and installing all materials, excavation, backfill, and all other work and incidentals necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 130 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

Removal of structures and obstructions for permanent roadway, parking lot, and gaging station construction shall be measured as a complete item of work and shall be paid for at the Lump Sum Price for the total quantity of acceptably removed structures and obstructions. The Lump Sum Price shall be full compensation for the removal, wholly or in part, and satisfactory disposal of all buildings, fences, structures, cattleguards, culverts, and other obstructions shown on the Drawings or located in the rights of way of this work, excepting those obstructions which are designated to remain or are to be removed and disposed of under other items of work. The Lump Sum Price shall include the salvaging of designated material, as shown on the Drawings, and backfilling the resulting trenches, holes, and pits.

ITEM NO. 131 - TYPE 1 FIELD LABORATORY

A Type 1 field laboratory shall be measured and paid for at the Lump Sum Price for the installed and accepted field laboratory. The Lump Sum Price shall be full compensation for labor, equipment, materials, and all work necessary to furnish, install, and remove the field laboratory in accordance with the Drawings and Specifications and as directed by the Owner.
ITEM NO. 132 - TRAFFIC CONTROL DURING CONSTRUCTION

Traffic control during construction shall be paid for through a Force Account. Payment shall be authorized cost plus time and materials and shall be full compensation for labor, equipment, materials, and all other work necessary for traffic control where construction operations interfere with, obstruct, or create a hazard to, the movement of traffic in accordance with the Specifications and as directed by the Owner. The Force Account for traffic control is $100,000.

ITEM NO. 133 - SITE GRADING-COMMON

Common excavation in site grading work for permanent roadways, parking lots, and the boat ramp shall be measured and paid for at the Unit Price per Cubic Yard of excavation for the accepted quantities. Common material shall be as defined in Section 2C--Excavation-Open Cut, and Section 2N--Topsoil Stripping. The Unit Price shall be full compensation for labor, equipment, topsoil stripping and placement, excavation, haul, stockpiling, material segregation, embankment, grading, shaping, compacting, wetting, drying, dewatering, disposal of waste excavated materials, and erosion and pollution control programs in accordance with the Drawings and Specifications.

ITEM NO. 134 - SITE GRADING-ROCK

Rock excavation in site grading work for permanent roadways, parking lots, and the boat ramp shall be measured and paid for at the Unit Price per Cubic Yard of excavation for the accepted quantities. Rock material shall be as defined in Section 2C--Excavation-Open Cut. The Unit Price shall be full compensation for labor, equipment, excavation, haul, stockpiling, material segregation, embankment, grading, shaping, compacting, wetting, drying, dewatering, disposal of waste excavated materials, and erosion and water pollution control programs in accordance with the Drawings and Specifications.

ITEM NO. 135 - SITE GRADING-UNCLASSIFIED

Unclassified excavation in site grading work for permanent roadways, parking lots, and the boat ramp shall be measured and paid for at the Unit Price per Cubic Yard of excavation for the accepted quantities. The Unit Price shall be full compensation for labor, equipment, erosion and water pollution control, excavation, disposal of unstable or unsuitable materials, materials excavated for channel modification beyond the limits of culvert trenching, and irrigation ditch modification or reconstruction in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 136 - SEEDING AND MULCHING

Seeding and mulching on obliterated roadways and disturbed areas adjacent to permanent roadways, parking lots, and the boat ramp shall be measured and paid for at the Unit Price per Acre measured on the ground for the accepted
quantities. The Unit Price shall be full compensation for labor, equipment, water, seed, fertilizer, mulch, and furnishing and applying all materials necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 137 - EXCELSIOR MATTING

Excelsior matting for erosion control on obliterated roadways and disturbed areas adjacent to permanent roadways, parking lots, and the boat ramp shall be measured and paid for at the Unit Price per Square Yard of accepted quantities. The Unit Price shall be full compensation for labor, equipment, matting, binders, incidentals, and installation necessary to complete the item in accordance with the Specifications at the locations designated by the Owner.

ITEM NO. 138 - ENGINEERING FABRIC

Engineering fabric for permanent roadways shall be measured and paid for at the Unit Price per Lineal Foot installed and accepted on a 32 foot wide finished subgrade surface. The Unit Price shall be full compensation for labor, equipment, and furnishing and installing all materials necessary to complete the item in accordance with the Drawings and Specifications.

ITEM NO. 139 - CRUSHED AGGREGATE SURFACE COURSE

Crushed aggregate surface course shall be measured and paid for at the Unit Price per Ton of accepted quantities. The Unit Price shall be full compensation for labor, equipment, borrow pit acquisition and permitting, weigh station, borrow pit reclamation, borrow pit haul road construction and obliteration, borrow pit and haul road revegetation, material processing, material segregation, stockpiling, haul, placement, shaping, wetting, drying, and compaction in accordance with the Drawings and Specifications.

ITEM NOS. 140,141,142,143,144,145,146,147, & 148 - CULVERTS AND STOCKPASSES

Culverts and stockpasses for permanent roadways shall be measured and paid for at the Unit Price per Lineal Foot of the size and type installed and accepted. The Unit Price shall be full compensation for labor, equipment, excavation, stream diversion, erosion and pollution control, and furnishing and installing culverts and stockpasses, couplings, bedding, backfill, riprap, and appurtenances necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

Modifications to the existing channel or watercourse beyond the ends of culverts and stockpasses, as directed by the Owner, shall be measured and paid as Site Grading-Unclassified.
ITEM NO. 149 - BARBED WIRE FENCE

Four-strand barbed wire fence installed along easements and rights of way shall be measured and paid for at the Unit Price per Lineal Foot installed and accepted. Lengths for line brace panels, corner panels, end panels, and wire fence gates shall not be included in the measurement of barbed wire fence installed. The Unit Price shall be full compensation for labor, equipment, clearing, grubbing, and furnishing and installing posts, wire, wire stays, and appurtenances necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 150 - BRACE PANELS

Line brace panels for barbed wire fence shall be measured and paid for at the Unit Price for Each brace panel installed and accepted. The Unit Price shall be full compensation for labor, equipment, clearing, grubbing, and furnishing and installing all materials necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 151 - END PANELS

End panels for barbed wire fence shall be measured and paid for at the Unit Price for Each end panel installed and accepted. The Unit Price shall be full compensation for labor, equipment, clearing, grubbing, and furnishing and installing all materials necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 152 - CORNER PANELS

Corner panels for barbed wire fence shall be measured and paid for at the Unit Price for Each corner panel installed and accepted at locations designated by the Owner. The Unit Price shall be full compensation for labor, equipment, clearing, grubbing, and furnishing and installing all materials necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 153 - WIRE FENCE GATES

Wire fence gates for barbed wire fence shall be measured and paid for at the Unit Price for Each gate installed and accepted. The Unit Price shall be full compensation for labor, equipment, clearing, grubbing, and furnishing and installing all materials necessary to complete the item in accordance with the Drawings and Specifications and as directed by the Owner.

ITEM NO. 154 - TEMPORARY FENCE

Temporary fence installed for the construction period only shall be measured and paid for at the Unit Price per Lineal Foot installed and accepted. The Unit Price shall be full compensation for labor, equipment, clearing,
grubbing, furnishing, installing, and subsequent removal of posts, wire, line
brace panels, end posts, gates, stays, mounting hardware, and appurtenances
necessary to complete the item in accordance with the Drawings and
Specifications and as directed by the Owner.

ITEM NO. 155 - TRAFFIC CONTROL SIGNS

Signs for permanent roadways and parking lots shall be measured and paid for
at the Unit Price per Square Foot of sign installed and accepted. The Unit
Price shall be full compensation for labor, equipment, and furnishing and
installing posts, signs, mounting hardware, and appurtenances necessary to
complete the item in accordance with the Drawings and Specifications and as
directed by the Owner.

ITEM NO. 156 - 24' CATTLEGUARD

Twenty-four foot heavy duty cattleguards shall be measured and paid for at
the Unit Price per Each as installed and accepted. The Unit Price shall be
full compensation for labor, equipment, excavation, and furnishing and
installing the base, grates, wings, delineators, fence "tie-ins", and
appurtenances necessary to complete the item in accordance with the Drawings
and Specifications and as directed by the Owner.

ITEM NO. 157 - 30' CATTLEGUARD

Thirty foot heavy duty cattleguards shall be measured and paid for at the
Unit Price per Each as installed and accepted. The Unit Price shall be full
compensation for labor, equipment, excavation, and furnishing and installing
the base, grates, wings, delineators, fence "tie-ins", and appurtenances
necessary to complete the item in accordance with the Drawings and
Specifications and as directed by the Owner.

ITEM NO. 158 - GUARDRAIL Guardrail for permanent roadways and parking lots
shall be measured and paid for at the Unit Price per Lineal Foot installed
and accepted. The Unit Price shall be full compensation for labor, equipment,
and furnishing and installing posts, blocks, corrugated metal
beam, end members, reflectors, mounting hardware, and appurtenances necessary
to complete the item in accordance with the Drawings and Specifications and
as directed by the Owner.

ITEM NO. 159 - OBLITERATION OF ABANDONED ROADWAYS

Obliteration of abandoned roadways shall be measured and paid for at the Unit
Price per Acre measured on the ground for the accepted quantities. The Unit
Price shall be full compensation for labor, equipment, materials, ripping,
plowing, scarifying, contouring, shaping, erosion control and all incidentals
necessary to complete the item in accordance with the Drawings and
Specifications and as directed by the Owner.
CONDITIONS OF THE CONTRACT
STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT

Prepared by
Engineers' Joint Contract Documents Committee

and

Issued and Published Jointly By

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN CONSULTING ENGINEERS COUNCIL

AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General Contractors of America

These General Conditions have been prepared for use with the Owner-Contractor Agreements (No. 1910-8-A-1 or 1910-8-A-2, 1983 editions). Their provisions are interrelated and a change in one may necessitate a change in the others. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents, No. 1910-9, 1981 edition. For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. 1910-17, 1983 edition). When bidding is involved, the Standard Form of Instructions to Bidders (No. 1910-12, 1983 edition) may be used.
TABLE OF CONTENTS OF GENERAL CONDITIONS

<table>
<thead>
<tr>
<th>Article Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DEFINITIONS</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>PRELIMINARY MATTERS</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>CONTRACT DOCUMENTS: INTENT, AMENDING AND REUSE</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>BONDS AND INSURANCE</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>CONTRACTOR'S RESPONSIBILITIES</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>OTHER WORK</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>OWNER'S RESPONSIBILITIES</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>ENGINEER'S STATUS DURING CONSTRUCTION</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>CHANGES IN THE WORK</td>
<td>21</td>
</tr>
<tr>
<td>11</td>
<td>CHANGE OF CONTRACT PRICE</td>
<td>21</td>
</tr>
<tr>
<td>12</td>
<td>CHANGE OF CONTRACT TIME</td>
<td>24</td>
</tr>
<tr>
<td>13</td>
<td>WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>ACCEPTANCE OF DEFECTIVE WORK</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>PAYMENTS TO CONTRACTOR AND COMPLETION</td>
<td>26</td>
</tr>
<tr>
<td>15</td>
<td>SUSPENSION OF WORK AND TERMINATION</td>
<td>29</td>
</tr>
<tr>
<td>16</td>
<td>ARBITRATION</td>
<td>31</td>
</tr>
<tr>
<td>17</td>
<td>MISCELLANEOUS</td>
<td>32</td>
</tr>
</tbody>
</table>
INDEX TO GENERAL CONDITIONS

Article or Paragraph Number

Acceptance of Insurance ........................................... 5.13
Access to the Work .................................................. 13.2
Addenda—definition of (see definition of Specifications) .... 1
Agreement—definition of ............................................. 1
All Risk Insurance ..................................................... 5.6
Amendment, Written ................................................. 1, 3.1.1
Application for Payment—definition of ......................... 1
Application for Payment, Final ..................................... 14.12
Application for Progress Payment ................................. 14.2
Application for Progress Payment—review of ................. 14.4-14.7
Arbitration ............................................................. 16
Authorized Variation in Work ........................................ 9.5
Availability of Lands .................................................. 4.1
Award, Notice of—defined .......................................... 1

Before Starting Construction ................................. 2.5-2.7
Bid—definition of ....................................................... 1
Bonds and Insurance—in general .................................. 5
Bonds—definition of ................................................... 1
Bonds, Delivery of ...................................................... 2.1, 5.1
Bonds, Performance and Other ...................................... 5.1-5.2

Cash Allowances ......................................................... 11.8
Change Order—definition of ......................................... 1
Change Orders—to be executed ..................................... 10.4
Changes in the Work .................................................. 10
Claims, Waiver of—on Final Payment ........................... 14.16
Clarifications and Interpretations .................................. 9.4
Cleaning ............................................................... 6.17
Completion ............................................................. 14
Completion, Substantial ............................................. 14.8-14.9
Conference, Preconstruction ........................................ 2.8
Conflict, Error, Discrepancy—Contractor to Report .......... 2.5, 3.3
Construction Machinery, Equipment, etc. ...................... 6.4
Continuing Work ....................................................... 6.29
Contract Documents—amending and supplementing .......... 3.4-3.5
Contract Documents—definition of ................................ 1
Contract Documents—Intent ......................................... 3.1-3.3
Contract Documents—Reuse of ...................................... 3.6
Contract Price, Change of ........................................... 11
Contract Price—definition ............................................. 1
Contract Time, Change of ........................................... 12
Contract Time, Commencement of ................................... 2.3
Contract Time—definition of ......................................... 1
Contractor—definition of ............................................. 1
Contractor May Stop Work or Terminate ......................... 15.5
Contractor’s Continuing Obligation ............................... 14.15
Contractor’s Duty to Report Discrepancy in Documents ... 2.5, 3.2
Contractor’s Fee—Cost Plus .......................................... 11.4.5.6, 11.5.1, 11.6-11.7
Contractor’s Liability Insurance ................................... 5.3
Contractor’s Responsibilities—in general ......................... 6

Contractor’s Warranty of Title .................................... 14.3
Contractors—other ..................................................... 7
Contractual Liability Insurance ..................................... 5.4
Coordinating Contractor—definition of ......................... 7.4
Coordination ........................................................... 7.4
Copies of Documents ................................................ 2.2
Correction or Removal of Defective Work ....................... 13.11
Correction Period, One Year ....................................... 13.12
Correction, Removal or Acceptance of Defective Work .... 13.11-13.14
Cost—net decrease .................................................... 11.6.2
Cost of Work .......................................................... 11.4-11.5
Costs, Supplemental .................................................. 11.4.5

Day—definition of ...................................................... 1
Defective—definition of .............................................. 1
Defective Work, Acceptance of ..................................... 13.13
Defective Work, Correction or Removal of ......................... 13.11
Defective Work—in general .......................................... 13.14
Defective Work, Rejecting ........................................... 9.6
Definitions .............................................................. 1
Delivery of Bonds ....................................................... 2.1
Determination for Unit Prices ....................................... 9.10
Disputes, Decisions by Engineer .................................. 9.11-9.12
Documents, Copies of ............................................... 2.2
Documents, Record ..................................................... 6.19
Documents, Reuse ...................................................... 3.6
Drawings—definition of ............................................. 1

Easements ............................................................... 4.1
Effective date of Agreement—definition of ...................... 1
Emergencies ............................................................. 6.22
Engineer—definition of ............................................... 1
Engineer’s Decisions .................................................... 9.10-9.12
Engineer’s—Notice Work is Acceptable ......................... 14.13
Engineer’s Recommendation of Payment ........................ 14.4.14.13
Engineer’s Responsibilities, Limitations on .................... 6.6, 9.11, 9.13-9.16
Engineer’s Status During Construction—in general .......... 9
Equipment, Labor, Materials and Equipment .................... 6.3-6.6
Equivalent Materials and Equipment .............................. 6.7
Explorations of physical conditions ............................... 4.2

Fee, Contractor’s—Costs Plus ....................................... 11.6
Field Order—definition of ............................................ 1
Field Order—issued by Engineer ..................................... 3.5.1.9.5
Final Application for Payment ....................................... 14.12
Final Inspection ........................................................ 14.11
Final Payment and Acceptance ..................................... 14.13
Final Payment, Recommendation of ................................ 14.13-14.14

General Provisions .................................................... 17.3-17.4
General Requirements—definition of ............................. 1
General Requirements—principal references to ............... 2.6, 4.4, 6.4, 6.6-6.7, 6.23
GENERAL CONDITIONS

ARTICLE I—DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

Addenda—Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

Agreement—The written agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment—The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to include such supporting documentation as is required by the Contract Documents.

Bid—The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bonds—Bid, performance and payment bonds and other instruments of security.

Change Order—A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents—The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all amendments, modifications and supplements issued pursuant to paragraphs 3.4 and 3.5 on or after the Effective Date of the Agreement.

Contract Price—The moneys payable by OWNER to CONTRACTOR under the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

Contract Time—The number of days (computed as provided in paragraph 17.2) or the date stated in the Agreement for the completion of the Work.

CONTRACTOR—The person, firm or corporation with whom OWNER has entered into the Agreement.

defective—An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

Drawings—The drawings which show the character and scope of the Work to be performed and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents.

Effective Date of the Agreement—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER—The person, firm or corporation named as such in the Agreement.

Field Order—A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Time.

General Requirements—Sections of Division 1 of the Specifications.

Laws and Regulations; Laws or Regulations—Laws, rules, regulations, ordinances, codes and/or orders.

Notice of Award—The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

Notice to Proceed—A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

OWNER—The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

Partial Utilization—Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

Project—The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

Resident Project Representative—The authorized representative of ENGINEER who is assigned to the site or any part thereof.
Shop Drawings—All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

Specifications—Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor—An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

Substantial Completion—The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if there be no such certificate issued, when final payment is due in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.

Supplementary Conditions — The part of the Contract Documents which amends or supplements these General Conditions.

Supplier—A manufacturer, fabricator, supplier, distributor, materialman or vendor.

Underground Facilities—All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Unit Price Work—Work to be paid for on the basis of unit prices.

Work—The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

Work Directive Change—A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.22. A Work Directive Change may not change the Contract Price or the Contract Time, but is evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.2.

Written Amendment—A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly Work-related aspects of the Contract Documents.

ARTICLE 2—PRELIMINARY MATTERS

Delivery of Bonds:

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Time; Notice to Proceed:

2.3. The Contract Time will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the Contract Time commence to run later than the seventy-fifth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Project:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown
thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents, unless CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. an estimated progress schedule indicating the starting and completion dates of the various stages of the Work;

2.6.2. a preliminary schedule of Shop Drawing submissions; and

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be confirmed in writing by CONTRACTOR at the time of submission.

2.7. Before any Work at the site is started, CONTRACTOR shall deliver to OWNER, with a copy to ENGINEER, certificates (and other evidence of insurance requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with paragraphs 5.3 and 5.4, and OWNER shall deliver to CONTRACTOR certificates (and other evidence of insurance requested by CONTRACTOR) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7.

Preconstruction Conference:

2.8. Within twenty days after the Effective Date of the Agreement, but before CONTRACTOR starts the Work at the site, a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to discuss the schedules referred to in paragraph 2.6, to discuss procedures for handling Shop Drawings and other submittals and for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

Finalizing Schedules:

2.9. At least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with para-

graph 2.6. The finalized progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within the Contract Time, but such acceptability will neither impose on ENGINEER responsibility for the progress or scheduling of the Work nor relieve CONTRACTOR from full responsibility therefor. The finalized schedule of Shop Drawing submissions will be acceptable to ENGINEER as providing a workable arrangement for processing the submissions. The finalized schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe Work, materials or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.
from ENGINEER; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents unless CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

**Amending and Supplementing Contract Documents:**

3.4. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.4.1. a formal Written Amendment,

3.4.2. a Change Order (pursuant to paragraph 10.4), or

3.4.3. a Work Directive Change (pursuant to paragraph 10.1).

As indicated in paragraphs 11.2 and 12.1, Contract Price and Contract Time may only be changed by a Change Order or a Written Amendment.

3.5. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.5.1. a Field Order (pursuant to paragraph 9.5),

3.5.2. ENGINEER's approval of a Shop Drawing or sample (pursuant to paragraphs 6.26 and 6.27), or

3.5.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

**Reuse of Documents:**

3.6. Neither CONTRACTOR nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER; and they shall not reuse any of them on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER.

**ARTICLE 4—AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS**

**Availability of Lands:**

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR believes that any delay in OWNER's furnishing these lands, rights-of-way or easements entitles CONTRACTOR to an extension of the Contract Time, CONTRACTOR may make a claim therefor as provided in Article 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

**Physical Conditions:**

4.2.1. **Explorations and Reports:** Reference is made to the Supplementary Conditions for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such reports, but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

4.2.2. **Existing Structures:** Reference is made to the Supplementary Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in paragraph 4.3) which are at or contiguous to the site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not for the completeness thereof for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

4.2.3. **Report of Differing Conditions:** If CONTRACTOR believes that:

4.2.3.1. any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is inaccurate, or

4.2.3.2. any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents,

CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.22), notify OWNER and ENGINEER in writing about the inaccuracy or difference.
4.2.4. **ENGINEER’s Review:** ENGINEER will promptly review the pertinent conditions, determine the necessity of obtaining additional explorations or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER’s findings and conclusions.

4.2.5. **Possible Document Change:** If ENGINEER concludes that there is a material error in the Contract Documents or that because of newly discovered conditions a change in the Contract Documents is required, a Work Directive Change or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the inaccuracy or difference.

4.2.6. **Possible Price and Time Adjustments:** In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to any such inaccuracy or difference. If OWNER and CONTRACTOR are unable to agree as to the amount or length thereof, a claim may be made therefor as provided in Articles 11 and 12.

**Physical Conditions—Underground Facilities:**

4.3.1. **Shown or Indicated:** The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and,

4.3.1.2. CONTRACTOR shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

4.3.2. **Not Shown or Indicated:** If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by paragraph 6.22), identify the owner of such Underground Facility and give written notice thereof to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of. If the parties are unable to agree as to the amount or length thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

**Reference Points:**

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER’s judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

**ARTICLE 5—BONDS AND INSURANCE**

**Performance and Other Bonds:**

5.1. CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR’s obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Law or Regulation or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of
the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within five days thereafter substitute another Bond and Surety, both of which must be acceptable to OWNER.

Contractor’s Liability Insurance:

5.3. CONTRACTOR shall purchase and maintain such comprehensive general liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR’s performance and furnishing of the Work and CONTRACTOR’s other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.3.1. Claims under workers’ or workmen’s compensation, disability benefits and other similar employee benefit acts;

5.3.2. Claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR’s employees;

5.3.3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR’s employees;

5.3.4. Claims for damages insured by personal injury liability coverage which are sustained (a) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (b) by any other person for any other reason;

5.3.5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom;

5.3.6. Claims arising out of operation of Laws or Regulations for damages because of bodily injury or death of any person or for damage to property; and

5.3.7. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The insurance required by this paragraph 5.3 shall include the specific coverages and be written for not less than the limits of liability and coverages provided in the Supplementary Conditions, or required by law, whichever is greater. The comprehensive general liability insurance shall include completed operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days’ prior written notice has been given to OWNER and ENGINEER by certified mail. All such insurance shall remain in effect until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing defective Work in accordance with paragraph 13.12. In addition, CONTRACTOR shall maintain such completed operations insurance for at least two years after final payment and furnish OWNER with evidence of continuation of such insurance at final payment and one year thereafter.

Contractual Liability Insurance:

5.4. The comprehensive general liability insurance required by paragraph 5.3 will include contractual liability insurance applicable to CONTRACTOR’s obligations under paragraphs 6.30 and 6.31.

Owner’s Liability Insurance:

5.5. OWNER shall be responsible for purchasing and maintaining OWNER’s own liability insurance and, at OWNER’s option, may purchase and maintain such insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance:

5.6. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and ENGINEER’s consultants in the Work, all of whom shall be listed as insureds or additional insured parties, shall insure against the perils of fire and extended coverage and shall include “all risk” insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in the Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the “all risk” insurance or otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER AND ENGINEER’s consultants in the Work, all of whom shall be listed as insured or additional insured parties.
5.8. All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to CONTRACTOR by certified mail and will contain waiver provisions in accordance with paragraph 5.11.2.

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are provided in the Supplementary Conditions. The risk of loss within the deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policy, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

Waiver of Rights:

5.11.1. OWNER and CONTRACTOR waive all rights against each other for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to paragraphs 5.6 and 5.7 and any other property insurance applicable to the Work, and also waive all such rights against the Subcontractors, ENGINEER, ENGINEER's consultants and all other parties named as insureds in such policies for losses and damages so caused. As required by paragraph 6.11, each subcontract between CONTRACTOR and a Subcontractor will contain similar waiver provisions by the Subcontractor in favor of OWNER, CONTRACTOR, ENGINEER, ENGINEER's consultants and all other parties named as insureds. None of the above waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2. OWNER and CONTRACTOR intend that any policies provided in response to paragraphs 5.6 and 5.7 shall protect all of the parties insured and provide primary coverage for all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds, and if the insurers require separate waiver forms to be signed by ENGINEER or ENGINEER's consultant OWNER will obtain the same, and if such waiver forms are required of any Subcontractor, CONTRACTOR will obtain the same.

Receipt and Application of Proceeds:

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. OWNER as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as trustee shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If required in writing by any party in interest, OWNER as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of such duties.

Acceptance of Insurance:

5.14. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.3 and 5.4 on the basis of its not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.7. If CONTRACTOR has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 on the basis of their not complying with the Contract Documents, CONTRACTOR shall notify OWNER in writing thereof within ten days of the date of delivery of such certificates to CONTRACTOR in accordance with paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request. Failure by OWNER or CONTRACTOR to give any such notice of objection within the time provided shall constitute acceptance of such insurance purchased by the other as complying with the Contract Documents.

Partial Utilization—Property Insurance:

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no
such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effect the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or lapse on account of any such partial use or occupancy.

ARTICLE 6—CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3. CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to ENGINEER, or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

Adjusting Progress Schedule:

6.6. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) adjustments in the progress schedule to reflect the impact thereon of new developments; these will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

Substitutes or "Or-Equal" Items:

6.7.1. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers may be accepted by ENGINEER if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. The procedure for review by ENGINEER will include the following as supplemented in the General Requirements. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or
royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR's expense additional data about the proposed substitute.

6.7.2. If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in paragraph 6.7.1 as applied by ENGINEER and as may be supplemented in the General Requirements.

6.7.3. ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute. ENGINEER will record time required by ENGINEER and ENGINEER's consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's consultants for evaluating each proposed substitute.

Concerning Subcontractors, Suppliers and Others:

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be increased by the difference in the cost occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

6.9. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER and contains waiver provisions as required by paragraph 5.11. CONTRACTOR shall pay each Subcontractor a just share of any insurance moneys received by CONTRACTOR on account of losses under policies issued pursuant to paragraphs 5.6 and 5.7.

Patent Fees and Royalties:

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER
or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

Permits:

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or if there are no Bids on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR observes that the Specifications or Drawings are at variance with any Laws or Regulations, CONTRACTOR shall give ENGINEER prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in paragraph 3.4. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to such Laws or Regulations, and without such notice to ENGINEER, CONTRACTOR shall bear all costs arising therefrom: however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against OWNER or ENGINEER by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold OWNER and ENGINEER harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against OWNER or ENGINEER to the extent based on a claim arising out of CONTRACTOR's performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Directive Changes, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon com-
completion of the Work, these record documents, samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all employees on the Work and other persons and organizations who may be affected thereby;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR). CONTRACTOR’s duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.21. CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR’s superintendent unless otherwise designated in writing by CONTRACTOR to OWNER.

Emergencies:

6.22. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or OWNER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Work Directive or Change Order will be issued to document the consequences of the changes or variations.

Shop Drawings and Samples:

6.23. After checking and verifying all field measurements and after complying with applicable procedures specified in the General Requirements, CONTRACTOR shall submit to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing submissions (see paragraph 2.9), or for other appropriate action if so indicated in the Supplementary Conditions, five copies (unless otherwise specified in the General Requirements) of all Shop Drawings, which will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR’s responsibilities under the Contract Documents with respect to the review of the submission. All submissions will be identified as ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to review the information as required.

6.24. CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR’s responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.

6.25.1. Before submission of each Shop Drawing or sample CONTRACTOR shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples and with the requirements of the Work and the Contract Documents.

6.25.2. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on
each Shop Drawing submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve with reasonable promptness Shop Drawings and samples, but ENGINEER’s review and approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER’s review and approval of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER’s attention to each such variation at the time of submission as required by paragraph 6.25:2 and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the provisions of paragraph 6.25:1.

6.28. Where a Shop Drawing or sample is required by the Specifications, any related Work performed prior to ENGINEER’s review and approval of the pertinent submission will be the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as CONTRACTOR and OWNER may otherwise agree in writing.

Indemnification:

6.30. To the fullest extent permitted by Laws and Regulations CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and their consultants, agents and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom and (b) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder or arises by or is imposed by Law and Regulations regardless of the negligence of any such party.

6.31. In any and all claims against OWNER or ENGINEER or any of their consultants, agents or employees by any employee of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.30 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor or other person or organization under workers’ or workmen’s compensation acts, disability benefit acts or other employee benefit acts.

6.32. The obligations of CONTRACTOR under paragraph 6.30 shall not extend to the liability of ENGINEER, ENGINEER’s consultants, agents or employees arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications.

ARTICLE 7—OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by OWNER’s own forces, have other work performed by utility owners or let other direct contracts therefor which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to CONTRACTOR prior to starting any such other work; and, if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

7.2. CONTRACTOR shall afford each utility owner and other contractor who is a party to such a direct contract (or OWNER, if OWNER is performing the additional work with OWNER’s employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs. CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CON-
TRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If any part of CONTRACTOR's Work depends for proper execution or results upon the work of any such other contractor or utility owner (or OWNER), CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. CONTRACTOR's failure so to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in the other work.

Coordination:

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the Supplementary Conditions, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided, in the Supplementary Conditions. Unless otherwise provided in the Supplementary Conditions, neither OWNER nor ENGINEER shall have any authority or responsibility in respect of such coordination.

ARTICLE 8—OWNER'S RESPONSIBILITIES

8.1. OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER. Any dispute in connection with such appointment shall be subject to arbitration.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and in existing structures which have been utilized by ENGINEER in preparing the Drawings and Specifications.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.8.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

ARTICLE 9—ENGINEER'S STATUS DURING CONSTRUCTION

Owner's Representative:

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations as an experienced and qualified design professional, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defects and deficiencies in the Work.

Project Representation:

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in observing the performance of the Work. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions. If OWNER designates another agent to represent OWNER at the site who is not ENGINEER's agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Supplementary Conditions.
Clarifications and Interpretations:

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If CONTRACTOR believes that a written clarification or interpretation justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER, and also on CONTRACTOR who shall perform the Work involved promptly. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

Rejecting Defective Work:

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, and will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7. In connection with ENGINEER’s responsibility for Shop Drawings and samples, see paragraphs 6.23 through 6.29 inclusive.

9.8. In connection with ENGINEER’s responsibilities as to Change Orders, see Articles 10, 11 and 12.

9.9. In connection with ENGINEER’s responsibilities in respect of Applications for Payment, etc., see Article 14.

Determinations for Unit Prices:

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER’s preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER’s written decisions thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other party to the Agreement and to ENGINEER written notice of intention to appeal from such a decision.

Decisions on Disputes:

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Time will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph, which ENGINEER will render in writing within a reasonable time. Written notice of each such claim, dispute and other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the occurrence of the event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after such occurrence unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 and 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter.

Limitations on ENGINEER’s Responsibilities:

9.13. Neither ENGINEER’s authority to act under this Article 9 or elsewhere in the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

9.14. Whenever in the Contract Documents the terms “as ordered”, “as directed”, “as required”, “as allowed”, “as approved” or terms of like effect or import are used, or the adjectives “reasonable”, “suitable”, “acceptable”, “proper” or “satisfactory” or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be
effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

9.15. ENGINEER will not be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.16. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

ARTICLE 10—CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by a Written Amendment, a Change Order, or a Work Directive Change. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made therefor as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.4 and 3.5, except in the case of an emergency as provided in paragraph 6.22 and except in the case of uncovering Work as provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders (or Written Amendments) covering:

10.4.1. changes in the Work which are ordered by OWNER pursuant to paragraph 10.1, are required because of acceptance of defective Work under paragraph 13.13 or correcting defective Work under paragraph 13.14, or are agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Time which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11—CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

11.3.1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1. through 11.9.3, inclusive).
11.3.2. By mutual acceptance of a lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2.1).

11.3.3. On the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's Fee for overhead and profit (determined as provided in paragraphs 11.6 and 11.7).

Cost of the Work:

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof—all in accordance with terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses), not compensated by insurance or otherwise, to the Work or otherwise sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's Fee. If, however, any such loss or damage
requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work and premiums for property insurance coverage within the limits of the deductible amounts established by OWNER in accordance with paragraph 5.9.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR’s officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR’s principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4—all of which are to be considered administrative costs covered by the CONTRACTOR’s Fee.

11.5.2. Expenses of CONTRACTOR’s principal and branch offices other than CONTRACTOR’s office at the site.

11.5.3. Any part of CONTRACTOR’s capital expenses, including interest on CONTRACTOR’S capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by sub-paragraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

11.5.6. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

**CONTRACTOR’s Fee:**

11.6. The CONTRACTOR’s Fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or if none can be agreed upon,

11.6.2. a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR’s Fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR’s Fee shall be five percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to CONTRACTOR on account of overhead and profit of all Subcontractors shall be fifteen percent;

11.6.2.3. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.4. the amount of credit to be allowed by CONTRACTOR to OWNER for any such change which results in a net decrease in cost will be the amount of the actual net decrease plus a deduction in CONTRACTOR’s Fee by an amount equal to ten percent of the net decrease; and

11.6.2.5. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR’s Fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.4, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 or 11.5, CONTRACTOR will submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

**Cash Allowances:**

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1. The allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR’s costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the
allowances. No demand for additional payment on account of any thereof will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

**Unit Price Work:**

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with Paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR’s overhead and profit for each separately identified item.

11.9.3. Where the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement and there is no corresponding adjustment with respect to any other item of Work and if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof, CONTRACTOR may make a claim for an increase in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the amount of any such increase.

**ARTICLE 12—CHANGE OF CONTRACT TIME**

12.1. The Contract Time may only be changed by a Change Order or a Written Amendment. Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant’s written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of CONTRACTOR if a claim is made therefor as provided in paragraph 12.1. Such delays shall include, but not be limited to, acts or neglect by OWNER or others performing additional work as contemplated by Article 7, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God.

12.3. All time limits stated in the Contract Documents are of the essence of the Agreement. The provisions of this Article 12 shall not exclude recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) for delay by either party.

**ARTICLE 13—WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

**Warranty and Guarantee:**

13.1. CONTRACTOR warrants and guarantees to OWNER and ENGINEER that all Work will be in accordance with the Contract Documents and will not be defective. Prompt notice of all defects shall be given to CONTRACTOR. All defective Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 13.

**Access to Work:**

13.2. ENGINEER and ENGINEER’s representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide proper and safe conditions for such access.

**Tests and Inspections:**

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals.

13.4. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval. CONTRACTOR shall also
be responsible for and shall pay all costs in connection with any inspection or testing required in connection with OWNER’s or ENGINEER’s acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR’s purchase thereof for incorporation in the Work. The cost of all inspections, tests and approvals in addition to the above which are required by the Contract Documents shall be paid by OWNER (unless otherwise specified).

13.5. All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to OWNER and CONTRACTOR (or by ENGINEER if so specified).

13.6. If any Work (including the work of others) that is to be inspected, tested or approved is covered without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation. Such uncovering shall be at CONTRACTOR’s expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR’s intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.7. Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from CONTRACTOR’s obligations to perform the Work in accordance with the Contract Documents.

Uncovering Work:

13.8. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER’s observation and replaced at CONTRACTOR’s expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER’s request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, CONTRACTOR shall bear all direct, indirect and consequential costs of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys and other professionals), and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be defective, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

Owner May Stop the Work:

13.10. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any other party.

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with nondefective Work. CONTRACTOR shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) made necessary thereby.

One Year Correction Period:

13.12. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER’s written instructions, either correct such defective Work, or, if it has been rejected by OWNER, remove it from the site and replace it with nondefective Work. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) will be paid by CONTRACTOR. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER’s recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall bear all direct, indirect and consequential
costs attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice of ENGINEER to proceed to correct and to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees such access to the site as may be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of OWNER in exercising such rights and remedies will be charged against CONTRACTOR in an amount approved as to reasonableness by ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court and arbitration costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's defective Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14—PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment:

14.2. At least twenty days before each progress payment is scheduled (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Ten days after presentation of the Application for Payment with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a
representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the Work in progress as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules that the Work has progressed to the point indicated; that, to the best of ENGINEER's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation); and that CONTRACTOR is entitled to payment of the amount recommended. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER's recommendation of final payment will constitute an additional representation by ENGINEER to OWNER that the conditions precedent to CONTRACTOR's being entitled to final payment as set forth in paragraph 14.13 have been fulfilled.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such recommendations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is defective, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.14, or

14.7.4. of ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.9 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work or Liens have been filed in connection with the Work or there are other items entitling OWNER to a set-off against the amount recommended, but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the definitive certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforementioned recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10. Use by OWNER of any finished part of the Work, which has specifically been identified in the Contract Docu-
ments, or which OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and useable part of the Work that can be used by OWNER without significant interference with CONTRACTOR’s performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2. OWNER may at any time request CONTRACTOR in writing to permit OWNER to take over operation of any such part of the Work although it is not substantially complete. A copy of such request will be sent to ENGINEER and within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER that such part of the Work is not ready for separate operation by OWNER, ENGINEER will finalize the list of items to be completed or corrected and will deliver such list to OWNER and CONTRACTOR together with a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on said list and to complete other related Work.

14.10.3. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

Final Application for Payment:

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents—all as required by the Contract Documents, and after ENGINEER has indicated that the Work is acceptable (subject to the provisions of paragraph 14.16), CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER’s property might in any way be responsible, have been paid or otherwise satisfied; and consent of the surety, if any, to final payment. If any Subcontractor or Supplier fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

Final Payment and Acceptance:

14.13. If, on the basis of ENGINEER’s observation of the Work during construction and final inspection, and ENGINEER’s review of the final Application for Payment and accompanying documentation—all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR’s other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER’s recommendation of payment and present the Application to OWNER for payment. Thereupon ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.16.
Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER’s recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR’s final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

**Contractor’s Continuing Obligation:**

14.15. CONTRACTOR’s obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by ENGINEER, nor the issuance of a certificate of Substantial Completion, nor any payment by OWNER to CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by OWNER, nor any act of acceptance by OWNER nor any failure to do so, nor any review and approval of a Shop Drawing or sample submission, nor the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13, nor any correction of defective Work by OWNER will constitute an acceptance of Work not in accordance with the Contract Documents or a release of CONTRACTOR’s obligation to perform the Work in accordance with the Contract Documents (except as provided in paragraph 14.16).

**Waiver of Claims:**

14.16. The making and acceptance of final payment will constitute:

14.16.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.11 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR’s continuing obligations under the Contract Documents; and

14.16.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

**ARTICLE 15—SUSPENSION OF WORK AND TERMINATION**

**Owner May Suspend Work:**

15.1. OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

**Owner May Terminate:**

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency;

15.2.2. if a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;

15.2.3. if CONTRACTOR makes a general assignment for the benefit of creditors;

15.2.4. if a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR’s creditors;

15.2.5. if CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

15.2.6. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents
(including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as revised from time to time);

15.2.7. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.8. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.9. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if there be one) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER will be approved as to reasonableness by ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs).

Contractor May Stop Work or Terminate:

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted, or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, terminate the Agreement and recover from OWNER payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if ENGINEER has failed to act on an Application for Payment or OWNER has failed to make any payment as aforesaid, CONTRACTOR may upon seven days' written notice to OWNER and ENGINEER stop the Work until payment of all amounts then due. The provisions of this paragraph shall not relieve CONTRACTOR of the obligations under paragraph 6.29 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with OWNER.

[The remainder of this page was left blank intentionally.]
ARTICLE 16 - ARBITRATION

[This Article intentionally omitted]
[This page was left blank intentionally.]
ARTICLE 17—MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Time:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight shall constitute a day.

General:

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.30, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply. All representations, warranties and guarantees made in the Contract Documents will survive final payment and termination or completion of the Agreement.
SUPPLEMENTARY CONDITIONS

1. GENERAL -

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplemental Conditions which are defined in the Standard General Conditions of the Construction Contract have the meanings assigned to them in the General Conditions.

In resolving such conflicts, errors and discrepancies, the documents shall be given precedence in the following order: Agreement, Modifications, Addenda, Supplemental General Conditions, Instructions to Bidders, General Conditions, Specifications, and Drawings. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings. Any work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for. Work, materials, or equipment described in words which so applied have a well-known technical or trade meaning shall be deemed to refer to such recognized standards.

The parties hereto agree that in the event it becomes necessary to determine the meaning, scope, or interrelationship of any of the provisions of the Agreement, the doctrine of contra proferentium, that is, that the Contract Documents shall be construed against the Owner, shall not be used. On the contrary, interpretation shall be based on a reasonable basis consistent with the provisions and intent of the article entitled Prebid Conference, in the Instructions to Bidders.

SC-2.2 -

Delete paragraph 2.2 of the General Conditions in its entirety and insert the following in its place:

The Owner shall furnish to the Contractor Contract Documents in accordance with Section 1D.1.10 of the General Requirements.

SC-3.3A -

Add a new paragraph immediately after paragraph 3.3 of the General Conditions which is to read as follows:

In resolving such conflicts, errors, and discrepancies, the documents shall be given precedence in the following order: Agreement, Modifications, Addenda, Supplemental General Conditions, Instructions to Bidders, General Conditions, Specifications, and Drawings. Figure dimensions on Drawings
shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings. Any Work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for. Work, materials, or equipment described in words which so applied have a well-known technical or trade meaning shall be deemed to refer to such recognized standards.

SC-4.2.1 -

Add the following language at the end of paragraph 4.2.1 of the General Conditions: The report of explorations and tests of subsurface conditions is listed in Appendix A of these specifications as "Technical Data - Subsurface Investigations May, 1986" prepared by Chen & Associates, Inc.

SC-5.3 -

Add the following language at the end of paragraph 5.3 of the General Conditions:

The limits of liability for the insurance required by paragraph 5.3 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

5.3.1 and 5.3.2. Worker's Compensation, etc. under paragraphs 5.3.1 and 5.3.2 of the General Conditions:

(1) State: Statutory
(2) Applicable Federal (e.g. Longshoreman's): Statutory
(3) Employer's Liability: $___________

5.3.3, 5.3.4, 5.3.5, and 5.3.6. Comprehensive General Liability (under paragraphs 5.3.3 through 5.3.6 of the General Conditions):

(1) Bodily Injury (including completed operations and products liability):

$______________

Each Occurrence

$______________

Annual Aggregate

Property Damage:

$______________

Each Occurrence

$______________

Annual Aggregate

or a combined single limit of

(2) Property Damage liability insurance will provide Explosion, Collapse and Underground coverages where applicable.

SC-2
(3) Personal Injury, with employment exclusion deleted
$---------------

Annual Aggregate

5.3.7. Comprehensive Automobile Liability:

Bodily Injury:
$---------------

Each Person

$---------------

Each Occurrence

Property Damage:
$---------------

Each Occurrence

or combined single limit of
$---------------

SC-5.4 -

Add the following language at the end of paragraph 5.4 of the General Conditions:

The Contractual Liability required by paragraph 5.4 of the General Conditions shall provide coverage for not less than the following amounts:

5.4.1 Bodily Injury:
$---------------

Each Occurrence

5.4.2 Property Damage:
$---------------

Each Occurrence

$---------------

Annual Aggregate

SC-5.7A -

Add a new paragraph immediately after paragraph 5.7 of the General Conditions which is to read as follows: Owner shall purchase and maintain flood and earthquake insurance which will include the interests of Owner, Contractor, Subcontractors, Engineer, and Engineer's Consultants in the Work, all of whom shall be listed as insured or additional insured parties.

SC-6.8.2A -

Add a new paragraph immediately after paragraph 6.8.2 of the General Conditions which is to read as follows:

CONTRACTOR shall submit to OWNER and ENGINEER a list of all proposed subcontractors and suppliers of principal items of equipment and materials, as detailed herein, within seven (7) days after the Bid opening. CONTRACTOR shall identify all proposed subcontractors and list which items of work, or components of the Project, which that subcontractor will work on. Suppliers of principal items of equipment and material shall also be identified for, at minimum, the following: control valves, meters, tunnel lining, bifurcations, piping,
meters, concrete, and gondola.

SC-6.13 -
Amend the first and second line of paragraph 6.13 of the General Conditions to substitute the words "General Requirements" for "Supplemental Conditions"; and as so amended paragraph 6.13 remains in effect.

SC-6.30 -
Amend the first sentence of paragraph 6.30 of the General Conditions to read as follows:

...CONTRACTOR shall indemnify and hold harmless the OWNER, ENGINEER and United States Government and their consultants.....

and as so amended paragraph 6.30 remains in effect.

SC-9.3A -
Add a new paragraph immediately after paragraph 9.3 of the General Conditions which is to read as follows:

(To be inserted)

SC-11.4.5.3.A -
Add the following paragraphs immediately after paragraph 11.4.5.3 of the General Conditions which is to read as follows:

RENTAL RATES FOR EQUIPMENT USED ON FORCE ACCOUNT WORK.

Instructions as outlined herein shall be used by the Owner in the application and computations for equipment rental rates for equipment used on a force account basis.

1. The Rental Rate Blue Book for Construction Equipment published by the Equipment Guide-Book Company will be used to establish rental rates for all listed equipment. The area adjustment percentage for the state, as shown on the Rental Rate Blue Book will not be applied.

The equipment rental rates will be determined from the most recent Blue Book information available at the time the equipment begins work. The rental rate for each particular piece of equipment will be established on Form ERR-1 (see copy, Page 4) and this rate will remain in effect for the duration of that force account notwithstanding any subsequent Blue Book revisions.

2. The Total Hourly Rental Rate (without operator) for a designated item of equipment is comprised of a Bare Rate and a Service Rate,
representing ownership costs and operating costs respectively, in accordance with the following general criteria:

(a) Bare Rate (Ownership Costs): Includes depreciation, taxes, major overhaul and repairs, overhead, interest, area adjustment, insurance and storage.

(b) Service Rate (Operating Costs): Includes fuel, lubricants, labor for service and maintenance, field repairs, tires and other expendable items necessary for continuous and efficient operation.

3. Equipment rental rates based on the Blue Book will be determined in accordance with the following procedures:

(a) Bare Rate (Ownership Costs): Computed at 100% of the Blue Book Monthly Bare Rate as follows:

\[
\text{Hourly Bare Rate} = 1.00 \times \frac{\text{Blue Book Monthly Rate}}{8 \text{ hours} \times 5 \text{ days} \times 4 \text{ weeks}}
\]

(b) Service Rate (Operating Costs) = Blue Book Estimated Operating Cost/Hr.

(c) Total Hourly Rental Rate (w/o Operator) = Bare Rate + Service Rate.

Example: Rental Rate calculation for Motor Grader
(Blue Book, Section 9, Page 9-6, May, 1985)

Caterpillar, 14 "G" W/8-sp, P.S., 180 hp.

Hourly rate = \((1.0)(\text{Monthly Rate}) = \frac{(1.0)(8485.00)}{(8)(5)(4)}\)

Bare rate . . . . . . . . . . = $53.03/\text{Hr.}

Service rate. . . . . . . . = $18.25

Total Rental Rate . . . . . . . = $71.28

(w/o Operator)

Accessories will be paid for at 60% of the Blue Book hourly bare rate plus 100% of the Blue Book operating rate.

Once a rental rate is established for a particular piece of equipment on a project, the rate will not be changed for the duration of the project unless:

The Blue Book is updated during the project and the Contractor requests a rental rate change after the update but prior to doing the work.

4. In the case any machinery or equipment to be used is not listed in the Blue Book or established in this schedule, the Contractor shall request a rental rate determination, through the Owner by submitting
the required information on a completed Form ERR-1.

5. Manufacturer's identification plates attached to equipment will be used insofar as possible for the required information necessary for the determination of the equipment rental rate. Where the equipment is not provided with such plates or there is insufficient information on the plates, the Contractor will be required to supply written statements stipulating the required information as shown by his equipment inventory.

6. Form ERR-1 will be completed for each item of equipment used on force account work that is not listed in the Blue Book. One copy of the completed Form ERR-1 for each piece of unlisted equipment shall be attached to the CPT&M Contractor's time sheet for work performed. Each item of equipment will be numbered consecutively, beginning with the number one under Equipment Code No. on Form ERR-1.

Once Form ERR-1 has been completed for a particular piece of equipment, it is not necessary to duplicate this information for subsequent force account work on the same project. Reference to the appropriate code number previously assigned to the particular piece of equipment will be sufficient on any subsequent force account records.

7. In cases where the piece of equipment to be used is rented or leased from an outside agency and the rate charged by the agency exceeds the rate shown in the Blue Book or the piece of equipment is not listed in the Blue Book, the rental or lease agreement shall be submitted to the Owner for approval for use as payment for Force Account Work. A complete description of the conditions which would warrant the payment of higher rates should be included for consideration.

8. The rates to be used by the Contractor in submitting work orders shall be the total hourly rate without operator which is the sum of the Bare Rate (Ownership Costs) plus the Service Rate (Estimated Operating Cost per hour). Mobilization for equipment, normally on the job, that is involved in force account work is included in the bid item mobilization. No adjustment will be added to the Total Hourly Rate for fuel costs or horsepower difference from standard engine ratings.

"Move-in" charges required for a piece of equipment not available on the job, or not available at the specific site of force account work within 10 miles, shall be included as extra work at actual transportation cost, if the particular piece of equipment is not moved onto the specific site of force account work under its own power. Total hours, less one full hour, will be allowed for equipment moved to the specific site of Force Account work under its own power. This shall apply to equipment moved within the limits of the project. No operator charges shall be allowed for equipment moved under its own power to work sites. No "move out" charges shall be allowed.

9. The equipment used for force account work shall be of such size and capacity and so handled and used to provide normal output or
production required for the work to be done.

10. The equipment rental rates to be paid will include power control units and all basic attachments and accessories that are physically included on the unit used, even though a particular attachment is not actually used. The Owner will determine if it is more desirable to use equipment available on the project or to request other equipment and pay resulting move-in costs in accordance with Paragraph 8.

11. The duration of equipment operation each day will be computed to the nearest 1/2 hour. If the total period of operation is less than one hour, the rental period will be considered to be one full hour.

[The remainder of this page intentionally left blank.]
# FORM ERR-1
## EQUIPMENT RENTAL RATE DETERMINATION

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>CONTRACTOR</th>
<th>LOCATION OF WORK:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DESCRIPTION OF WORK:</th>
<th></th>
</tr>
</thead>
</table>

### EQUIPMENT DATA

<table>
<thead>
<tr>
<th>EQUIPMENT CODE NO.</th>
<th>ACQUISITION COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MAKE</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MODEL</th>
<th>SERIES</th>
<th>SERIAL NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MANUFACTURER'S RATED CAPACITY OR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENGINE(S) (Type: Gasoline, Diesel, etc.)</th>
<th>(Horsepower)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSMISSION (Direct Drive, Torque Drive, Power Shift, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTACHMENTS/ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REMARKS (Include estimated hours of equipment rental)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBMITTED BY</th>
<th>DATE</th>
<th>REVIEWED BY</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RATE DETERMINATION

<table>
<thead>
<tr>
<th>BARE RATE</th>
<th>=</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVICE RATE</td>
<td>=</td>
<td>SIGNATURE</td>
</tr>
<tr>
<td>TOTAL HOURLY RATE (W/O OPERATOR)</td>
<td>=</td>
<td>DATE</td>
</tr>
</tbody>
</table>
EXPLANATION FOR FORM ERR-1

1. Equipment Code No.: Each piece of equipment used on the project for force account work will be numbered consecutively beginning with number one (See Paragraph No. 6 under "Instructions").

2. Acquisition Cost: This cost is the original acquisition cost of the piece of equipment for which an equipment rental rate is being determined as purchased from a manufacturer or dealer and such cost will not include sales tax and shipping.

3. Type: Indicate the type of equipment such as crawler loader; wheel loader; self-propelled scraper; hydraulic shovel-crawler mounted, etc. Be concise but include all pertinent information. If room is insufficient, use back of sheet.

4. Make: Show brand name or name of manufacturer.

5. Weight: Show the total weight of the piece of equipment for which a rental rate is being determined. This weight is needed to compute freight costs.

6. Attachments/Accessories: Show all accessories which will influence the Total Hourly Rate computed for the Equipment being rated.

NOTE: Show any additional pertinent information concerning the piece of equipment on the back of Form ERR-1 that is not specifically called for on the face of the form.

SC-11.10 -

Add a new paragraph immediately after paragraph 10.9 of the General Conditions which shall be titled and is to read as follows:

No Damage for Delay:

No charge shall be made by the CONTRACTOR for hinderances or delays from any cause whatsoever in the progress of the work.

SC-14.2 -

Amend the first sentence of paragraph 14.2 of the General Conditions to read as follows:

At least thirty days before each progress payment..... and as so amended paragraph 14.2 remains in effect.
SC-14.8 -

Add the following language at the end of the first sentence of paragraph 14.8 of the General Conditions: The request for substantial completion shall be accompanied by all documents enumerated in Division 1, General Requirements, Section 1H, Project Closeout, paragraph 1.2 and included as part of these Specifications in Appendix B.

The remainder of paragraph 14.8 shall remain unchanged.

SC-15.1A -

Add a new paragraph immediately after paragraph 15.1 of the General Conditions which is to read as follows: The Owner shall by written order suspend the Work or any portion thereof until the next construction season due to weather conditions that the Owner deems unsuitable for the prosecution of the Work. The Owner shall also indicate a tentative date on which the Work will be resumed.

SC-16 -

Delete Article 16 - Arbitration in its entirety.

SC-17.5 -

Add a new paragraph immediately after paragraph 17.4 of the General Conditions which is to read as follows: Per Article 6.3 of these General Conditions, the Contractor shall be responsible for providing competent, suitably qualified personnel to perform the Work. If during the performance of the Work, the Owner determines that the Contractor has provided incompetent, unsuitably qualified personnel, the Owner shall notify the Contractor in writing and the Contractor shall replace said personnel within seven (7) days with competent, suitably qualified personnel.
STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR
ON THE BASIS OF A STIPULATED PRICE

Prepared by
ENGINEERS’ JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN CONSULTING ENGINEERS COUNCIL

AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General Contractors of America

This Standard Form of Agreement has been prepared for use with the Standard General Conditions of the Construction Contract, No. 1910-8, 1983 edition. Their provisions are interrelated and a change in one may necessitate a change in the others. The suggested language for instructions to bidders contained in the Guide to the Preparation of Instructions to Bidders, No. 1910-12, 1983 edition, is also carefully interrelated with the language of this Agreement. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents, No. 1910-9, 1981 edition. See also Guide to the Preparation of Supplementary Conditions, No. 1910-17, 1983 edition.
NOTE TO USER

Certain states and federal agencies require provisions in public contracts which permit Contractors to deposit acceptable securities with Owner or a stakeholder in lieu of retainage. Many Owners will not accept this procedure except where required by Laws or Regulations. In the event such a procedure is required, the provisions of this Agreement and possibly those of the other Contract Documents dealing with retainage should be amended, and an attorney should be consulted to prepare the revised language. Among the issues to be addressed by such language are: initial and subsequent valuations of the securities, right to withdraw excess collateral and obligation to deposit additional collateral as market value changes, who is entitled to interest and dividends on deposited collateral, rights of construction lender in deposited collateral, responsibilities of stakeholder, may collateral be freely sold in the event of Contractor default and method of such sale, and application of Uniform Commercial Code and state and federal security laws to the arrangement.
EJCDC
STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR
ON THE BASIS OF A STIPULATED PRICE

THIS AGREEMENT is dated as of the __________ day of ____________ in the
year 19______ by and between ____________________________________________
________________________________________________________ (hereinafter called OWNER) and
________________________________________________________ (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK.

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is
generally described as follows:

The Project for which the Work under the Contract Documents may be the whole or only a part is generally
described as follows:

Article 2. ENGINEER.

The Project has been designed by

who is hereinafter called ENGINEER and wishes to act as OWNER's representative, assume all duties and
responsibilities and have the right and authority assigned to ENGINEER in the Contract Documents in
connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIME.

3.1. The Work will be substantially completed on or before __________________, 19____, and
completed and ready for final payment in accordance with paragraph 14.13 of the General Conditions on
or before __________________, 19____.

3.2. Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this
Agreement and that OWNER will suffer financial loss if the Work is not completed within the times
specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of
the General Conditions. They also recognize the delays, expense and difficulties involved in proving in
a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on
time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as
liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER __________
_____________ dollars ($___________) for each day that expires after the time specified in paragraph 3.1 for Substantial Completion until the Work is
substantially complete. After Substantial Completion if CONTRACTOR shall neglect, refuse or fail to
complete the remaining Work within the Contract Time or any proper extension thereof granted by
OWNER, CONTRACTOR shall pay OWNER __________________ dollars ($________________) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE.

4.1. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds as follows:

[here insert a lump sum, unit prices or both, if necessary attach exhibits and list them in Article 8.]

[CONTRACTOR’s Bid may be attached as an exhibit to avoid lengthy retyping of unit price schedules, formulae for escalation of prices, information as to alternatives, etc.]

Article 5. PAYMENT PROCEDURES.

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1. Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR’s Applications for Payment as recommended by ENGINEER, on or about the ______ day of each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in paragraph 2.9 of the General Conditions (and in the case of Unit Price Work, based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

5.1.1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

_____ % of Work completed. If Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER on recommendation of ENGINEER, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no additional retainage on account of Work completed in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed.

_____ % of materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in paragraph 14.2 of the General Conditions).

5.1.2. Upon Substantial Completion, in an amount sufficient to increase total payments to CONTRACTOR to ______ % of the Contract Price, less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

5.2. Final Payment. Upon final completion and acceptance of the Work in accordance with paragraph 14.13 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraph 14.13.

Article 6. INTEREST.

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the maximum rate allowed by law at the place of the Project.
Article 7. CONTRACTOR’S REPRESENTATIONS.

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

7.1. CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2. CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in paragraph 4.2 of the General Conditions, and accepts the determination set forth in paragraph SC-4.2 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which CONTRACTOR is entitled to reply.

7.3. CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4. CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.3 of the General Conditions.

7.5. CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6. CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

Article 8. CONTRACT DOCUMENTS.

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

8.1. This Agreement (pages 1 to _____, inclusive).

8.2. Exhibits to this Agreement (pages _____ to _____, inclusive).

8.3. Performance and other Bonds, identified as exhibits _______________ and consisting of _____ pages.

8.4. Notice of Award.

8.5. General Conditions (pages _____ to _____, inclusive).

8.6. Supplementary Conditions (pages _____ to _____, inclusive).
8.7. Specifications bearing the title ______________________ 
and consisting of _____ divisions and _____ pages, as listed in table of contents thereof.

8.8. Drawings, consisting of a cover sheet and sheets numbered _____ through _____, inclusive with 
each sheet bearing the following general title:

[Fill in, and, if a set of Drawings is not attached to each signed counterpart of Agreement, so 
indicate, in which case OWNER and CONTRACTOR should initial or otherwise appropriately 
identify all Drawings.]

8.9. Addenda numbers _____ to _____, inclusive.

8.10. CONTRACTOR’s Bid (pages _____ to _____, inclusive) marked exhibit ______.

[Attach Bid Form only in special circumstances.]

8.11. Documentation submitted by CONTRACTOR prior to Notice of Award (pages _______ to 
________, inclusive).

8.12. The following which may be delivered or issued after the Effective Date of the Agreement and are 
not attached hereto: All Written Amendments and other documents amending, modifying, or supple-
menting the Contract Documents pursuant to paragraphs 3.4 and 3.5 of the General Conditions.

8.13. The documents listed in paragraphs 8.2 et seq. above are attached to this Agreement (except as 
expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents 
may only be amended, modified or supplemented as provided in paragraphs 3.4 and 3.5 of the General 
Conditions.

Article 9. MISCELLANEOUS.

9.1. Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the 
meanings indicated in the General Conditions.

9.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be 
binding on another party hereto without the written consent of the party sought to be bound; and 
specifically but without limitation moneys that may become due and moneys that are due may not be 
assigned without such consent (except to the extent that the effect of this restriction may be limited by 
law), and unless specifically stated to the contrary in any written consent to an assignment no assignment 
will release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.3. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal repre-
sentatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of 
all covenants, agreements and obligations contained in the Contract Documents.
IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on __________________________ 19 ___.

OWNER __________________________________________

By _________________________________________________

[CORPORATE SEAL]

Attest _______________________________________________

Address for giving notices __________________________________

_____________________________________________________

(If OWNER is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement.)

CONTRACTOR __________________________________________

By _________________________________________________

[CORPORATE SEAL]

Attest _______________________________________________

Address for giving notices __________________________________

_____________________________________________________

License No. __________________________________________

Agent for service of process: ____________________________

_____________________________________________________

(If CONTRACTOR is a corporation, attach evidence of authority to sign.)
Construction Performance Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address): 

SURETY (Name and Principal Place of Business): 

OWNER (Name and Address): 

CONSTRUCTION CONTRACT
Date: 
Amount: 
Description (Name and Location): 

BOND
Date (Not earlier than Construction Contract Date): 
Amount: 
Modifications to this Bond Form: 

CONTRACTOR AS PRINCIPAL
Company: 
(Corp. Seal) 
Signature: ________________________________ 
Name and Title: ____________________________ 

SURETY
Company: 
(Corp. Seal) 
Signature: ________________________________ 
Name and Title: ____________________________ 

CONTRACTOR AS PRINCIPAL
Company: 
(Corp. Seal) 
Signature: ________________________________ 
Name and Title: ____________________________ 

SURETY
Company: 
(Corp. Seal) 
Signature: ________________________________ 
Name and Title: ____________________________ 

Prepared through the joint efforts of The Surety Association of America, Engineers' Joint Contract Documents Committee, The Associated General Contractors of America, and the American Institute of Architects.
1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.

3. If there is no Owner Default, the Surety's obligation under this Bond shall arise after:

   3.1. The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below, that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and

   3.2. The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and

   3.3. The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

   4.1. Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract;

   4.2. Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors or

   4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or

   4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

      1. After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

      2. Deny liability in whole or in part and notify the Owner citing reasons therefor.

5. If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

6. After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:

   6.1. The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   6.2. Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

   6.3. Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

7. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

9. Any provision that is legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of the Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

   12.1. Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

   12.2. Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

   12.3. Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

   12.4. Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.
Construction Payment Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address): SURETY (Name and Principal Place of Business):

OWNER (Name and Address):

CONSTRUCTION CONTRACT

Date:
Amount:
Description (Name and Location):

BOND

Date (Not earlier than Construction Contract Date):
Amount:
Modifications to this Bond Form:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)
Signature: ________________________________
Name and Title:

SURETY

Company: (Corp. Seal)
Signature: ________________________________
Name and Title:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)
Signature: ________________________________
Name and Title:

SURETY

Company: (Corp. Seal)
Signature: ________________________________
Name and Title:

Prepared through the joint efforts of the Surety Association of America, Engineers' Joint Contract Documents Committee, The Associated General Contractors of America, American Institute of Architects, American Subcontractors Association, and the Associated Specialty Contractors.
1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract which is incorporated herein by reference.

2. With respect to the Owner, this obligation shall be null and void if the Contractor:
   2.1. Promptly makes payment, directly or indirectly, for all sums due.
   2.2. Defends, indemnifies and holds harmless the Owner from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:
   4.1. Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
   4.2. Claimants who do not have a direct contract with the Contractor:
      1. Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whose labor was done or performed; and
      2. Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of receiving the above notice any communication from the Contractor by which the Contractor has indicated that the claim shall be paid direct or indirectly; and
      3. Not having been paid within 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.

5. If a notice required by Paragraph 4 is given by the Owner to the Contractor or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:
   6.1. Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
   6.2. Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owner's prior, to use the funds for the completion of the work.

9. The Surety shall not be liable to the Owner. Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations of the Owner.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4.1 or Clause 4.2 (iii), or (2) on which the last labor or service was performed by anyone under the Construction Contract, whichever of (1) or (2) first occurs if the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as defense against the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered at the address shown on the signature page. Actual receipt of copy by the Surety, the Owner or the Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2. Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.
CERTIFICATE OF SUBSTANTIAL COMPLETION

OWNER's Project No. ..................................  

ENGINEER's Project No. ............................

Project .....................................................

CONTRACTOR .................................................

Contract For .............................................  

Contract Date ............................................

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To ..........................................................  

OWNER

And To .....................................................

CONTRACTOR

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _______ days of the above date of Substantial Completion.


Prepared by the Engineers' Joint Contract Documents Committee and endorsed by The Associated General Contractors of America.
The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

**RESPONSIBILITIES:**

**OWNER:**


**CONTRACTOR:**


The following documents are attached to and made a part of this Certificate:

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER on .........................., 19 ...........


By ..........................................................................

CONTRACTOR accepts this Certificate of Substantial Completion on ................................... , 19 ...........


By ..........................................................................

OWNER accepts this Certificate of Substantial Completion on ........................................... , 19 ...........


By ..........................................................................

*SAMPLE ONLY*
CERTIFICATE OF CONTRACTOR

that he is the __________________________ of __________________________, certifies that

the Contractor, in a Construction Contract No. ______________, dated ______________, 19___, entered into between the Contractor and ______________, the Owner for the construction of a Project, which bears the State of Wyoming, Water Development Commission, Project Designation ______________, and that he is authorized to and does make this certificate on behalf of said Contractor in order to induce the Owner to make payment to the Contractor, in accordance with the provisions of said Construction Contract.

Undersigned further says that all persons who have furnished labor in connection with said construction have been paid in full, and that the names of manufacturers, materialmen, and subcontractors that furnished material or services or both in connection with such construction and the kind of kinds of material or services or both so furnished are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Kind of Material and Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

and that the releases of liens executed by all such manufacturers, materialmen, and subcontractors have been furnished the owner.

________________________  __________________________
Date                                    Signature
WAIVER AND RELEASE OF LIEN

WHEREAS, the undersigned, ____________________________,
name of manufacturer, materialman, subcontractor
has furnished to ________________________________,
name of contractor
the following: _______________________________,
kind of material and services furnished
to ________________________________, and designated by the State of Wyoming,
name of borrower
Water Development Commission as
State of Wyoming Water Development Commission
Project Designation

NOW, THEREFORE, the undersigned, ________________________________,
name of manufacturer, materialman, or
subcontractor

and other good and valuable consideration, the receipt whereof is hereby acknowledged, do(es) hereby waive and release any and all liens, or right to claim of lien, on the above described project and premises, under any law, common or statutory, on account of labor or materials, or both, heretofore or hereafter furnished by the undersigned to or for the account of said ________________________________, for said project.

name of contractor

Given under my (our) hand(s) and seal(s) this _____ day of ____________,
19____.

Name of Manufacturer, Materialman, or
Subcontractor

By
President, Vice-President, Partner, or
Owner, or, if signed by other than one of
the foregoing, accompanied by power of
attorney signed by one of the foregoing
in favor of the signer. (Use designation
applicable.)
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 1A - SUMMARY OF WORK

1.1 DESCRIPTION OF PROJECT

The Deer Creek Dam Project consists of a 280 foot high concrete faced, compacted rock-filled dam, reservoir, diversion tunnel, cascade spillway, outlet works tunnel and control building, access road improvements, stream gaging stations, boat ramp, telemetry and control systems, and other miscellaneous work. The majority of the work is located on Deer Creek at the south end of lower Deer Creek Canyon in Sections 11, 12, 13, 14, 21, 22 and 23 T31N, R77W and Sections 7 and 18 T31N, R76W, Converse County, Wyoming. The project is approximately 23 miles southeast of Casper in the Laramie Range. The elevation of the project ranges from 6400 to 6800 feet above mean sea level.

Deer Creek Dam is being constructed to provide 65,785 acre-feet of water for flood control and additional water supply to the municipalities of Casper, Evansville, Douglas, Glenrock, and other North Platte Valley communities.

The Deer Creek Dam shall be a compacted rock-filled dam with an upstream concrete face. The dam shall be 280 feet high, have a crest width of 20 feet, a crest length of 880 feet, and it shall contain approximately 1.3 million cubic yards of compacted rock. The concrete face shall be reinforced concrete 12 inches thick at the crest, which shall be thickened to 18 inches where the face ties into the plinth. The face shall contain approximately 9,600 cubic yards of concrete. The plinth is a reinforced concrete structure that ties the face slab into the foundation.

The plinth will also serve as the cap for the grout curtain. The plinth shall contain approximately 2,100 cubic yards of concrete. The top of the concrete face will tie into a reinforced concrete retaining wall 15 feet high and 890 feet long. This structure shall contain approximately 1,300 cubic yards of concrete.

The spillway, located in the left abutment, shall be a cascade spillway with a concrete channel, a concrete ogee crest and a concrete stilling basin totaling approximately 4,800 cubic yards of concrete. The spillway excavation shall provide the material for the compacted rock fill in the dam. The spillway is capable of passing 46,958 cubic feet per second at maximum high water line.

Stream diversion shall be accomplished by constructing a 14-foot diameter modified horseshoe tunnel 2,000 feet long through the right abutment and by constructing two cofferdams; one upstream of the dam, and one downstream of the dam. The diversion tunnel shall be unlined and it shall require the excavation of approximately 15,000 cubic yards of rock. The upstream cofferdam shall be a zoned earthfill embankment 46 feet high with a crest width of 30 feet and a crest length of 240 feet. The cofferdam shall contain approximately 27,000 cubic yards of material. The downstream cofferdam shall be a zoned earthfill 20 feet
high with a crest width of 12 feet and a crest length of 170 feet. The cofferdam shall contain approximately 7,000 cubic yards of material.

The outlet works shall consist of a reinforced concrete intake structure, a 1,000 foot long steel-lined tunnel through the right abutment, and a reinforced concrete control building with a bifurcated outlet system. The outlet works tunnel shall use approximately 420 feet of the diversion tunnel.

The access road improvement shall consist of two roads that total approximately 8 miles of widening, horizontal and vertical alignment improvements to existing roads and 8 miles of new road. The access roads shall have a 24-foot wide, crushed aggregate traveled way.

Seven gaging stations shall be constructed to monitor flows into and out of the reservoir. A reinforced concrete bridge over the spillway shall be constructed. A parking lot and a reinforced concrete boat ramp shall also be constructed.

1.2 WORK UNDER THIS CONTRACT

Work under this contract shall include, but not be limited to, the clearing of the reservoir area; the clearing of the spillway area; construction of the diversion tunnel; construction of two cofferdams; excavation for the plinth; construction of the plinth; construction of the compacted rock fill dam; excavation and construction of the cascade spillway; construction of the reinforced concrete face on the dam; construction of the outlet works intake structure; construction of the steel lined outlet works tunnel; construction of the reinforced concrete control building; construction of the manifold system; installation of all control valves; construction of an access road from the spillway to the crest of the dam; construction of a gondola; grouting of dam, spillway, and tunnel; construction of a bridge over the spillway; construction of access roads from the dam to existing county roads; construction of a parking lot; construction of a reinforced concrete boat ramp; construction of seven gaging stations; and all other equipment and/or materials required for the complete construction of the Deer Creek Dam Project.

1.3 OTHER CONTRACTS

None.

1.4 WORK TO BE PERFORMED LATER

None.

1.5 ITEMS PROVIDED BY OWNER

None.

1.6 CONSTRUCTION PHOTOGRAPHS

The Engineer shall be responsible for project record photographs. The photographs shall be a visual record of the construction progress and
upon completion of the project shall become a part of the construction records. Reproduction of these photos shall be made only upon the written approval of all contracting parties. Payment for reproduction of these photos shall be the responsibility of the party requesting reproduction.

1.7 OWNER OCCUPANCY

The Owner intends to place in service, in accordance with the provisions for use of completed work set forth in the General Conditions, Article 14.10, the facilities listed in Subsections 1.1 and 1.2 of this section, as soon as they are substantially complete and ready for their intended use.

1.8 CONSTRUCTION PROCEDURES AND SCHEDULES

a. Procedures... Construction procedures shall be determined by Contractor with the concurrence of the resident Project Representative. Water requirements of downstream users will be met through regulations administered by the State Board Of Control and directed through the Owner and Engineer.

b. Scheduled Events... Contractor shall schedule the work to conform to the events and dates as follows:

Data not available at time of printing.

End of Section
SECTION 1B - ALTERNATES

1.1 SUBSTITUTE EQUIPMENT OR MATERIALS
Substitution of equipment or materials shall be in accordance with the General Conditions, Article 6.7.

1.2 SUBSTITUTE METHODS
Contractor must make all requests for substitutions of methods in writing to Engineer, and these requests must be approved in writing by the Engineer. The request for substitution shall be submitted after award of the contract and shall be submitted previous to the scheduled work for which the method is intended. The substitute method shall have 10 years of certified, documented performance on projects of similar size and scope.

1.3 ALTERNATES AFFECTING PROJECT SCOPE
None.

End of Section
SECTION 1C - PROGRESS AND PAYMENT

========================================
1.1 MEASUREMENT OF QUANTITIES

Under this contract all work completed and meeting specifications, as certified by the Engineer, shall be measured by the Engineer according to the United States standard measures. The method of measurement and computations to be used in determination of quantities of materials furnished and of work performed under this contract shall be those methods generally recognized as conforming to good engineering practices.

Unless otherwise specified longitudinal measurements shall be made horizontally, and transverse measurements shall be neat dimensions shown on the plans or ordered in writing.

Items which are measured by the lineal foot, such as pipe culverts, underdrains, fence, etc., shall be measured parallel to the base or foundations upon which the items are placed, unless otherwise noted in the Drawings or Specifications.

Items which are measured by the acre shall be measured along the actual slope of the ground.

Embankment or excavation quantities shall be measured by standard survey methods. Computation of these quantities shall be made using the average end area method.

Structures shall be measured according to design lines shown on the Drawings or as altered to fit field conditions.

Lump sum items shall not be measured for payment. However, measurements may be made to monitor work progress. These items shall include all necessary materials, installation, and performance and acceptance testing.

Contractor shall find no additional monetary relief other than bid unit prices for overruns or underruns not exceeding fifteen percent (15%) of original unit price bid quantities. Quantity overruns or underruns exceeding fifteen percent (15%) of original unit price bid quantities shall be subject to the provisions of the General Conditions, Article 11.

When at the direction of the Engineer force account work is performed, measure of equipment, materials, and labor shall be the total actual units used in the work performed, including travel time within the limits of the project site. No allowances shall be made for Contractor related standby time of labor or equipment. Documentation for this work shall be presented to and approved by the Engineer at the end of each work day.

Standard manufactured items such as fence, wire, plates, rolled shapes, pipe conduit, etc., are identified by gage, unit weight, section dimensions, etc. This identification shall be considered to be the nominal weights or dimensions. Unless more stringently controlled in these cited specifications, manufacturing tolerances established by the
industry involved shall be accepted.

1.2 WORK PROGRESS

Progress of completed work shall be monitored by comparing the accumulated monthly work progress of both individual items of the project or the overall project to the progress shown on the project CPM and bar chart schedules. Should Contractor fall behind the work progress schedule, Contractor shall take such steps as may be necessary to improve his progress, without additional cost to Owner. Continued failure to adequately regain and follow the project schedule(s) shall be the basis for increasing the retention of individual item(s) or of the total request, to as much as, but not exceeding forty percent (40%) of, the individual item(s) or total pay request monies.

1.3 SCOPE OF PAYMENT

The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, labor, and equipment, and for performing all work under the contract and for all risks, loss, damage, or expense of whatever character arising from the nature of the work or the prosecution thereof, subject to the provisions of the General Conditions, Article 14.

Basis of payment in these Specifications relating to any unit price in the bid schedule requires said unit price shall cover and be considered compensation for the work or materials essential to that item, and this same work or materials shall not be measured or paid for under any other item which may appear elsewhere in the Drawings and Specifications.

1.4 PROGRESS PAYMENTS

On or about the 1st day of each month, Contractor shall submit to Owner through Engineer an itemized invoice for the work accomplished during the preceding calendar month for which partial payment shall be made on or about the 30th day of that month on basis of estimates thereof certified by Contractor, and approved by Engineer and Owner for the purpose of payment. However, approval of the partial pay request shall not mean final acceptance of that partially completed work. In estimating the amount of construction accomplished, consideration shall be given only to equipment and materials incorporated into the project, and equipment and materials delivered and appropriately stored at the project site or at bonded, insured, and approved warehouses in accordance with these General Requirements, Subsection 1.6 of this section. Unless otherwise specified, only ninety percent (90%) of each estimate approved during the construction of the project shall be paid by Owner to Contractor prior to the completion of the project.

No payment shall be due while Contractor is in default in respect of any of the provisions of this contract, and Owner may withhold from Contractor the amount of any claim by a third party against either Contractor or Owner based upon an alleged failure by Contractor to perform the work hereunder in accordance with the provisions of this contract.
1.5 PARTIAL PAYMENT

------------
Prior to requesting the first pay estimate, Contractor shall submit to Owner through Engineer for approval in duplicate, full and complete detailed accounting breakdown estimate of all materials and construction activities, with subordinate items relative thereto included in the contract Scope of Work. The components and activities described shall be itemized indicating quantity and billing price. Cost shall be apportioned into the expected contract price of materials and installation with total accumulated sums thereof equal to the contract price. All monthly pay requests must be supported with acceptable documentation, i.e. bills of lading, vendor invoices, shop drawings, material receipt forms, etc. for purposes of projecting contract cash flow to contract completion, the accounts described shall be apportioned by Contractor on a monthly time basis, based on the material and installation billing price, following expected Contractor performance. The anticipated cash flow schedule shall be updated by the Contractor every sixty (60) days after award of contract, and shall be submitted with every monthly pay request. No invoices for payment shall be honored unless these requirements have been accomplished. All change orders issued shall be itemized and cash flowed on an individual basis and as prescribed above. The Pay Request Form shall be provided by the Owner.

1.6 PAYMENT FOR STORED MATERIALS

----------------
Partial payment may be made for materials to be incorporated in the project and stockpiled on site or stored in acceptable storage facilities off the limits of the project site, in accordance with the General Requirements, Subsection 1.4 of this section. The material shall meet the requirements of these Specifications, and in no case will the partial payment exceed the total material(s) bid price. Partial payment for materials in storage shall not constitute acceptance, and facility materials may be condemned even though previous payment(s) have been made. Contractor shall be responsible for the protection of the material(s) against loss or damage while in storage. Partial payment for material(s) purchased by the Contractor may be made as verified by copies of paid invoices or paid freight bills. Contractor may request partial payment for material he has produced and stockpiled. The partial payment shall be made in accordance with the following "before retainage" stipulations:

A. Material to be incorporated in the project without further processing or treatment except for the addition of water to better facilitate compaction shall be made at fifty percent (50%) of the material price.

B. Material to be incorporated in the project after undergoing further processing, treatment, or blending with other materials, and provided the unit bid price is based on the mixture, payment will be based on twenty-five percent (25%) of the material cost.

C. All payments made for stored materials; materials to be incorporated into the project without further processing or treatment; or materials to be incorporated into the project after undergoing further processing, treatment, or blending with other materials shall be subject to retainage per Section 1C - 1.4 Progress Payments.

1C-3
1.7 SUBSTANTIAL COMPLETION

At the time of substantial completion as evidenced by the issuing of the Certificate of Substantial Completion in accordance with the Specifications, the Owner may reduce the retainage by 50%.

1.8 FINAL PAYMENT

After the construction project is completed to the satisfaction of Engineer as prescribed by the Supplementary Conditions, Section 14.11, Owner and Contractor will be promptly notified in writing that the work is acceptable subject to the provisions set forth under the following closeout forms of which the Contractor will submit three completed sets of each:

Certificate of Completion
Certificate of Contractor
Waiver And Release of Lien

After receipt of Contract Closeout Approval by the Owner, final payment will be in order which will include the entire sum after deducting all previous payments and all amounts to be retained or deducted under the provisions of the contract, and the project shall be advertised as complete. On the 41st day after the first date of publication advertising the project as complete, and upon approval of the Final Pay Estimate by Owner, said Contractor shall be paid the entire sum due. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

End of Section
SECTION 1D - SUBMITTALS

1.1 CONSTRUCTION SCHEDULES

As prescribed in the General Conditions, Article 2.6, the Contractor shall submit five copies of the tentative schedules to Engineer for review for information and coordination, only. The schedules shall be in the form of CPM, bar chart, monthly cash flow forecast, borrow area management plan, and shall indicate manpower forecast, shop drawings, and materials procurement. In addition, Contractor shall submit a list of all subcontractors, and labor, equipment, and material costs to include Contractor's fees for overhead and profit for changes in contract work. No pay estimates shall be approved until the Engineer has reviewed and approved all items that are required by this subsection.

1.2 WORK PROGRESS SCHEDULE

A. Preparation... The Contractor shall prepare a detailed work progress schedule consisting of a critical path method (CPM) diagram, or diagrams, as specified below. The format of the network diagram may utilize either ADM (arrow diagraming method) or PDM (precedence diagraming method) at the Contractor's option, showing the proposed starting and completion dates for the various stages of the construction including any free and total float time, and shall be prepared such that it can be used to plot actual progress against proposed progress. The schedule shall be updated monthly.

B. Specifications applicable to Contractor's CPM network diagraming -

1. Each separate sheet shall include the project name, contract number, Contractor's name, and date of latest issue. If multiple diagrams are prepared, each must, in addition to the above, include a descriptive title of that portion of the work included therein.

2. Network diagrams shall show the order and interdependence of activities, indicating the sequence in which the work is to be performed as planned by the Contractor.

3. Five copies of network diagrams shall be submitted to Owner, one of which shall be reproducible.

4. Revised network diagrams shall be submitted when the Contractor's planned sequence is changed, when contract changes are made which affect the schedule, or when directed by Owner.

5. Activities shown on the CPM network diagrams shall include, as a minimum, field construction operations, submittal and approval of all shop drawings, procurement of material and equipment furnished by Contractor or Owner, interface activities performed by others upon which Contractor's schedule depends, and equipment installation and testing.

6. The following items define the term "activities" as it pertains to the contractor's CPM network:
   a. Each activity shall be a unit of work which requires an amount of time for its performance.
   b. Each activity shall be a logically separate part of the work, defined by an observable start and an observable finish.
   c. To establish the scope of an activity for CPM purposes, Contractor shall form a single activity from the largest grouping of related operations which permit a continuous and measurable flow of work and which can pro-
ceed without affecting or being affected by work of another Contractor.

d. The scope of an activity shall be small enough to permit a reasonable
appraisal of its status.

7. The following information shall be furnished on the network diagram for
each activity:
   a. Identifying number ("I" and "J" node designation for ADM; "work item"
number for PDM). (This same numbering system shall be employed for the
breakdown of work values used for progress payment purposes.);
   b. Description of the activity;
   c. Duration of the activity, in either calendar or working day units; and
   d. Manpower reference: the manpower requirements, by craft and man-hours,
to perform the activity.

8. In addition to the above, any activity whose start or finish date has
been specified elsewhere in these specifications shall reflect such speci-
cified date.

9. Activities which relate to the work of another Contractor shall be
identified on the network diagrams by a readily noticeable symbol.

C. Borrow Area Management Plan..... Contractor shall submit to Owner, as
specified in the General Requirements, Subsection 1.1 of this section,
three (3) copies of the borrow area management plan. This plan shall
include, but is not limited to, the following items: name of Construc-
tor’s borrow area manager; dates of scheduled events (clearing, strip-
ing, excavation, etc.); methods or construction techniques to be
utilized; equipment (amount and type) to be used; relationship of dis-
posal areas; proposed haul roads; drainage and sedimentation systems;
environmental controls; stockpiling, if any; additional exploration and
sampling; and area utilization of specific embankment zones. This plan
shall be consistent and integrated with both the CPM and bar chart
schedules. Partial payments will not be made for the item to which this
pertains until this plan has been submitted, reviewed, and approved by
Engineer and Owner.

D. Requirements for Submittal of Work Progress Schedules By Contractor –

1. Preliminary submittal of the work progress schedule shall be as in-
dicated in Subsection 1.1 of this section.

2. Contractor shall submit to Owner for acceptance a detailed work progress
schedule of the entire work under this contract within thirty (30) days
after date of Notice of Award.

3. Contractor shall participate in a review and evaluation by Engineer of
his detailed work progress schedule. Any changes necessary as a result
of this review shall be made by Contractor and the work progress
schedule resubmitted within ten (10) days after the review for ac-
ceptance by Engineer. The accepted work progress schedule shall then be
the schedule used by Contractor for performing his work, and for re-
porting progress. (Contractor shall submit the detailed work progress
schedule and obtain Engineer’s acceptance thereof prior to applying for
the first progress payment.) Contractor shall not change the accepted
work progress schedule without prior concurrence by Engineer.

4. Engineer may, from time to time, request Contractor furnish prints of
the accepted work progress schedule, and the work progress schedule of
other Contractors, reflecting Contractor’s schedule and associated in-
formation.
E. Procedures To Be Followed For Changes In Contractor's Work Progress Schedule -

1. If the Contractor proposes to make changes in the accepted work progress schedule, he shall notify the Owner in writing stating the reasons for the change and shall submit to Owner a revised network diagram incorporating such change within ten (10) days after acceptance of proposed change.

2. Owner may require changes in Contractor's accepted work progress schedule in order to secure timely completion of the total project work. If such changes are deemed necessary by Engineer, he will notify Contractor of the nature of the changes required. Contractor shall then revise and submit for acceptance all of the affected portion of the work progress schedule within ten (10) days after notification by Engineer.

F. The Owner shall not pay any monies to the Contractor until the CPM schedule has been submitted and reviewed by the Owner.

1.3 WORK PROGRESS REPORTS

A. Reports.....Contractor shall submit each month a report reflecting actual work progress. Work progress reports shall consist of marked copies of the computer printout furnished by Contractor. (This printout will list the various activities as defined and listed in Subsection 1.2 of this section.) Markings shall include actual dates for activities started and/or completed during the report period, together with percentage completion status.

In addition there shall be a milestone or bar chart type schedule submitted and updated on a monthly basis.

B. Narrative Report.....Work progress reports shall be supplemented by a narrative report which shall include the following as a minimum:

1. A description of current and anticipated delaying factors, if any;
2. Impact of any potential delaying factors; and
3. Proposed corrective actions.

C. Partial Payment Applications.....The monthly work progress report, marked to indicate percentage completion status, shall serve as a backup to validate partial payment applications. Work reported complete but not readily apparent to Engineer must be supported by acceptable documentation.

D. Noncompliance With Schedule.....If the Contractor falls behind the accepted work progress schedule, weekly reports may be required, and the Contractor shall take it upon himself to take such steps as may be necessary to improve his progress including, but not limited to, increasing the number of shifts, overtime operations, and/or work days, and shall submit for approval such supplementary schedule(s) as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, without additional cost to the Owner.
E. If the Contractor fails to comply with this section, the Owner shall not process any payment requests until the Contractor is in compliance with this Section as determined by the Owner.

1.4 COORDINATION CONFERENCES

A. Scheduling, Attendance, Agenda.... A coordination conference shall be held at least once each week and at other times requested by Owner. Contractor, Owner, Engineer, and all subcontractors active on the site shall be represented at each conference. Contractor may at his discretion request attendance by representatives of his suppliers, manufacturers, and other subcontractors. Contractor shall submit to Engineer proposed agenda items at least twenty-four (24) hours in advance of each scheduled coordination conference.

B. Submittals..... Contractor and each subcontractor shall submit a schedule for work anticipated during the next week and shall be prepared to discuss the current work progress report as well as any anticipated future changes to the schedule. Format of all submittals submitted for these conferences shall be subject to approval by the Owner. Each subcontractor shall comment on the schedules of Contractor and other subcontractors and advise if their current progress or future anticipated schedules are compatible with his work.

c. Delay..... If one subcontractor’s work is delaying another’s work, Contractor shall direct such changes as are necessary for those involved to mutually agree on schedule changes in the best interest of work progress.

1.5 PROCUREMENT SCHEDULE

A. Contractor’s Submission..... Contractor shall prepare and submit with the work progress schedule a procurement schedule for equipment and materials to be furnished by him or his subcontractors, manufacturers, and suppliers, and which are not known to be regularly stocked by local suppliers or readily available upon short notice.

B. Owner’s Review..... Owner will review and comment on the procurement schedule.

C. Dates, Times..... Procurement schedule shall coincide with the work progress schedule and shall indicate the date each item will be needed at the site to avoid delay in construction, the time required for delivery after order is placed, the latest date for placement of order, and whether or not shop drawings are required.

D. Updates..... The accepted procurement schedule shall be updated at least once each month and submitted with the work progress report to show the status of orders placed, shop drawings, and delivery.

E. Copies of Purchase Orders..... Contractor shall furnish to Owner, if so requested, copies of any purchase order placed by him or his subcontractors.
F. Procurement schedule items of equipment and materials (minimum) -
[Data not available at time of printing.]

1.6 SHOP DRAWINGS

A. Submission.....Contractor shall prepare and submit, as a part of the
work progress schedule, a schedule for submission of all shop drawings
specified or necessary for Engineer's approval of the use of equipment
and materials proposed for incorporation in the work or needed for
proper installation, operation, or maintenance. Submission of all shop
drawings shall be scheduled to permit review, fabrication, and delivery
in time to cause no delay in the work of Contractor or his sub-
contractors or any other Contractors as described herein.

1. Contractor, in establishing his schedule for shop drawings shall allow
twenty (20) working days in Engineer's office for reviewing original
submittals and fifteen (15) working days in Engineer's office for re-
viewing resubmittals.

2. The schedule shall indicate the anticipated dates of original submission
for each item and Engineer's acceptance thereof, and shall be based upon
at least one resubmission of each item.

3. All shop drawings of equipment and materials furnished by sub-
contractors, manufacturers, and suppliers shall be submitted to Engineer
by Contractor.

4. All shop drawings required prior to fabrication or manufacture shall be
scheduled for submission within the time specified for each. Shop
drawings pertaining to storage, installation, and operation at the site
shall be scheduled for Engineer's acceptance prior to delivery of the
equipment or materials.

5. Shop drawings shall be resubmitted the number of times required for En-
gineer's "submittal accepted". However, any need for resubmittals in
excess of the number set forth in the accepted schedule, or any other
delay in obtaining acceptance of submittals, will not be grounds for ex-
tension of the contract time provided Engineer completes his reviews
within the times stated above.

B. Checking, Verification, Submittal.....After checking and verifying all
field measurements, Contractor shall transmit all shop drawings to En-
gineer for acceptance. Contractor shall:

1. Identify each submittal by contract title, number, and the specification
division and section number marked thereon or in the letter of trans-
mittal;

2. Check and approve submittals of subcontractors, suppliers, and manu-
facturers prior to transmitting them to Engineer. Contractor's approval
shall constitute a representation to Owner and Engineer that Contractor
has either determined and verified all quantities, dimensions, field
construction criteria, materials, catalog numbers, and similar data or
he assumes full responsibility for doing so, and that he has coordinated
each shop drawing with the requirements of the work and the Contract
Documents. The Contractor shall submit with each submittal the Cover
Page as attached herewith. No submittals will be accepted by the
Engineer without the Contractor's signature on the Cover Page (see
attached Cover Page).
3. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.

4. THE CONTRACTOR NOTES THE CONSPICUOUS NATURE OF THIS PROVISION. THE CONTRACTOR AGREES THAT THESE PROVISIONS ARE MATERIAL PROVISIONS AND ARE TO BE ENFORCED, IN THE EVENT OF CONTROVERSY (IF LEGALLY PERMISSIBLE AND CONSISTENT WITH THE INTENT OF THIS SPECIAL CAVAETORY PROVISION) IN SUCH A MANNER AS TO PLACE UPON THE CONTRACTOR FULL, COMPLETE AND TOTAL RESPONSIBILITY FOR THE SUBSEQUENT USEABILITY AND/OR COST OF REALIZING USEABILITY OF ANY AND ALL PRELIMINARY SUBMITTALS BY THE CONTRACTOR, WITHOUT REGARD TO ANY ACTION, OR FAILURE TO ACT IN CONNECTIONS THEREWITH, BY THE OWNER OR HIS DULY AUTHORIZING REPRESENTATIVE.

[The remainder of this page was left blank intentionally.]
TO FACILITATE THE ASSUMPTION OF RESPONSIBILITY BY THE CONTRACTOR UNDER SECTION 1D, PARAGRAPH 1.6.B OF THE GENERAL REQUIREMENTS, EACH SUBMITTAL BY THE CONTRACTOR SHALL CONTAIN AS A COVER PAGE THERETO, THE FOLLOWING LEGEND. THIS COVER PAGE SHALL BE SIGNED OR INITIALED BY A REPRESENTATIVE OF THE CONTRACTOR PREVIOUSLY DESIGNATED BY THE CONTRACTOR TO THE OWNER, IN WRITING, FOR SUCH PURPOSE.

a. This submittal is made under the provision of Section 1D of the General Requirements. Contractor makes an express warranty to the Owner, by express affirmation, that if installed into the project, the work which forms the basis of this submittal will conform to the design requirements of the Agreement, as that design has been contractually agreed to and which is the basis of the bargain between the parties thereto.

b. It is the purpose of this submittal to describe the goods proposed for use by the Contractor and to demonstrate conformance of that description to the Agreement requirement.

c. To the extent necessary, the Contractor by making this submittal, warrants that the whole of the goods shall conform to the submittal.

d. At the time of this submission, the Contractor acknowledges that he is aware that the purpose of this submission is to induce the Owner to authorize the use of this work for purposes of contract compliance by the Contractor, and, further that the Owner, in doing so, relies upon the skill, judgment, and integrity of the Contractor as to the compliance of this submitted work to the requirements of the Agreement. Contractor hereby acknowledges that he has by his own resources found and selected the work submitted herewith and that is suitable for the purpose of being fit and suitable for use in the final construction under this Agreement.

THE CONTRACTOR HEREBY NOTIFIES THE OWNER THAT:

1. 
2. 
3. 
4. 
5. FEATURES ARE NOT IN CONFORMANCE WITH THE AGREEMENT REQUIREMENTS AND NEVERTHELESS ASKS APPROVAL THEREOF.

Contractor's Representative

1D-7
C. Shop drawings to include the following:

1. Manufacturer's specifications;
2. Fabrication and erection drawings;
3. General outline drawings of equipment showing overall dimensions, location of major components, weights, and locations of required building openings and floor plates;
4. Detailed equipment installation drawings showing foundation details, anchor bolt sizes and locations, base plate sizes, location of Owner's connections, and all clearances required for erection, operation, and disassembly for maintenance;
5. Schematic diagrams for electrical items showing external connections, terminal block numbers, internal wiring diagrams, and one-line diagrams;
6. Bills of materials and spare parts lists;
7. Instruction books;
8. Samples, color charts, and similar items; and
9. All drawings, catalogs, or parts thereof, manufacturer's specifications, and data, samples, instructions, written guarantees, and other information specified or necessary:
   a. For Engineer to determine that the equipment and materials conform with the design concept and comply with the intent of the Contract documents;
   b. For the proper erection, installation, operation, and maintenance of the equipment and materials which Engineer will review for general content but not for substance; and
   c. For Engineer to determine what supports, anchorages, structural details, connections, and services are required for the equipment and materials, and the effects on contiguous or related structures, equipment, and materials.

Data submitted shall be complete with respect to dimensions, design criteria, materials of construction, and standards compliance, to enable Engineer to review the information effectively. Where standard drawings are furnished which cover a number of variations of the general class of equipment, each such drawing shall be individually annotated to describe exactly which parts of the drawing apply to the equipment being furnished. Such annotation shall also include proper identification of the submittal permanently attached to the drawing. Reproduction or copies of contract drawings or portions thereof will not be accepted as complete fabrication or erection drawings, but will be acceptable when used by Contractor as a drawing upon which to indicate information on erection or to identify detail drawings.

D. Instruction Books....Equipment instruction books shall be prepared by the manufacturer with loose-leaf pages mounted in durable covers and shall include but not be limited to the following:

1. Index and tabs;
2. Instructions for installation, start-up, operation, inspection, maintenance, parts lists, and recommended spare parts with corresponding exploded views and current prices, and data sheets showing model numbers;
3. Applicable drawings;
4. Address of nearest manufacturer-authorized service facility;
5. All additional data specified; and
6. Delivered six (6) weeks prior to installation.
E. Engineer’s Review.....Engineer will review and return shop drawings to Contractor with appropriate notations. Written guarantees and similar submittals received by Engineer will be reviewed for acceptance. Instruction books and similar submittals will be reviewed by Engineer for general content but not for substance. The approval for use of a separate item as such will not indicate approval for use of the assembly in which the item functions. Contractor shall make all modifications noted by Engineer at no additional cost to the Owner. Contractor shall make all modifications noted or indicated by Engineer and shall return revised prints, copies, or samples until accepted. Contractor shall direct specific attention in writing, or on revised submittals, to changes other than the modifications called for by Engineer on previous submittals. After submittals have been accepted, Contractor shall submit copies thereof for final distribution. Prints of accepted drawings transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, the submittal shall be corrected and resubmitted for review.

F. Distribution Submittals.....No item requiring shop drawings shall be considered for payment until approved distribution submittals have been received by the Engineer.

G. "Record Drawings" Submittals.....Following completion of a system and prior to final payment, the Contractor shall correct those drawings as necessary to reflect any field changes. After the work is completed on a system, the Contractor will submit six (6) copies by the same method of submittal as in this Subsection 1.6. All such copies shall be clearly marked "record drawings". The Engineer shall supply the Contractor with a set of mylar drawings for the purpose of "record drawings" submittal.

H. Acceptance By Engineer.....No work requiring a shop drawing shall be commenced or shipped until the submittal has been stamped "submittal accepted" or "submittal acceptable as noted" by Engineer. A copy or sample of each shop drawing shall be kept in good order by Contractor at the site.

I. Contractor’s Responsibilities.....Engineer’s acceptance of shop drawings will not relieve Contractor from his responsibility for any deviations from the requirements of the contract documents unless Contractor has in writing called Engineer’s attention to such deviation at the time of submission and Engineer has given written approval to the specific deviation, nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in shop drawings. Such deviation will be made a part of a contract amendment.

1.7 TRANSMITTAL AND REVIEW OF SHOP DRAWINGS

This item shall include manufacturer’s or fabricator’s shop drawings and specifications, catalog cuts, material samples, color charts, written guarantees, etc.

A. Initial Submittals And All Resubmittals From Contractor.....Six (6) copies of submittal, original copy of Contractor’s letter of trans-
mittal, and Cover Page to Engineer's Laramie, Wyoming, Office. (If Con-
tractor desires more than three reviewed submittals to be returned to
him, such additional copies, in excess of the six specified, shall be
submitted to Engineer.)

B. Distribution Of Shop Drawings.....Upon receipt of each shop drawing, En-
gineer will review, stamp with appropriate action, and distribute ini-
tial and resubmittals as follows:

1. Three (3) copies of submittal (or more if required by Contractor) and
original copy of Engineer's letter of transmittal to Contractor;
2. One (1) copy of submittal and one copy of transmittal to the Owner;
3. One (1) copy of submittal and one copy of transmittal to Engineer's
field office; and
4. One (1) copy of submittal and one (1) copy of transmittal to Engineer's
record department.

C. Submittals of equipment instruction books to be as follows –

1. Initial Submittal.....Four (4) copies to Engineer, one (1) copy returned
to Contractor.
2. Resubmittals.....Four (4) copies to Engineer, one (1) copy returned to
Contractor.

D. Written Guarantees.....Written guarantees shall be submitted in five (5)
copies, with two (2) copies returned to Contractor. The same numbers
apply for resubmittals.

E. Reference Submittals.....Compliance submittals for reference only will
be submitted in six (6) copies.

F. Engineer's Review.....Engineer's review action stamp, appropriately com-
pleted, will appear on all shop drawings of Contractor when returned by
Engineer.

Review status designations listed on Engineer's action stamp are defined
as follows:

"Submittal Accepted": Signifies equipment or material represented by
the submittal conforms with the design concept and complies with the in-
tent of the contract documents and is approved for incorporation in the
work. Contractor is to proceed with fabrication or procurement of the
items and with related work.

"Submittal Acceptable As Noted (Resubmit)"": Signified equipment or ma-
terial represented by the submittal conforms with the design concept and
complies with the intent of the contract documents and is approved for
incorporation in the work in accordance with Engineer's notations. Con-
tractor is to proceed with the work in accordance with Engineer's no-
tations and is to submit a revised submittal responsive to notations
marked on the returned submittal or written in the letter of trans-
mittal.

"Submittal Returned For Revision (Resubmit)": Signifies equipment or ma-
terial represented by the submittal appears to conform with the design
concept and comply with the intent of the contract documents but in-formation is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to re-submit revised information responsive to Engineer's annotations on the returned submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the submittal and related work is not to proceed until the submittal is acceptable.

"Submittal Not Acceptable (Submit Anew)": Signifies equipment or ma-terial represented by the submittal does not conform with the design concept or comply with the intent of the contract documents and is dis-approved for use in the work. Contractor is to submit compliance sub-mittals responsive to the contract documents.

"Preliminary Submittal": Signifies submittals of such preliminary na-ture that a determination of conformance with the design concept or compliance with the intent of the contract documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to pro-ceed.

"For Reference, No Acceptance Required": Signifies submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins, and similar data, all of which are useful to Engineer or Owner in design, operation, or main-tenance, but which by their nature do not constitute a basis for de-termining that items represented thereby conform with the design concept or comply with the intent of the contract documents. Engineer reviews such submittals for general content but not for substance.

"Distribution Copy (Previously Accepted)": Signifies submittals which have been previously accepted and are being distributed to Contractor, Owner, Resident Project Representative, and others for coordination and construction purposes.

1.8 TRANSMITTAL OF TEST REPORTS

Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of equipment, materials, and completed work are set forth in the Contract Documents. The party specified responsible for testing or inspection shall in each case, unless specified otherwise, arrange for the testing laboratory or reporting agency to distribute inspection and test reports and certificates as follows:

Owner---------------------------------1 copy
Engineer-----------------------------1 copy
Resident Project Representative-----1 copy
Contractor--------------------------2 copies
Manufacturer or Supplier------------1 copy

1.9 SHIPMENT SCHEDULES (AND ROUTING)

Shipment of equipment and materials shall be coordinated with the work progress schedule to eliminate the necessity for long periods of storage at the site.

1D-11
1.10 COPIES OF DOCUMENTS

A. Contractor's Sets.....Contractor will be provided at no cost to him a maximum of ten (10) sets of full-size Drawings including revised drawings, ten (10) sets of half-size drawings including revised drawings, and a maximum of ten (10) sets of the Contract Documents in addition to those used in execution of the contract. After awarding contract only full size drawings will be used for revisions.

B. Additional Copies.....Additional copies of above documents will be supplied at the following rates:

1) Sets of full-size contract drawings, including revised drawings $125.00 per set
2) Sets of half-size contract drawings, including revised drawings $100.00 per set
3) Sets of contract documents $ 75.00 per set
4) Revisions of contract drawings after award
   10 sets-no charge
   Above 10 sets-
   $1.25 per sheet
5) Revisions of contract documents
   After award
   10 sets-no charge
   Above 10 sets-
   $0.15 per sheet

1.11 MOBILIZATION

Mobilization shall cover preparatory work and operations including but not limited to those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings, trailers, and other facilities necessary for the work on the project and for all other work and operations which must be performed, or costs incurred prior to beginning work on the various items on the project.

Payment shall be made under the Contract Lump Sum Bid Item Mobilization according to the following schedule or as directed by the Owner.

1. 25% of the mobilization pay item price will be paid with the first payment request.

2. An additional 50% will be paid when the job is 30% complete based on partial payment without mobilization payments.

3. The final 25% of the pay item will be paid when the job is 60% complete based on partial payment without mobilization payments.

End of Section
SECTION 1E – RULES GOVERNING TESTING AND INSPECTION

1.1 TESTS AND INSPECTIONS

A. Inspection, Testing, Approval...shall be as prescribed in the General Conditions, Sections 13.3, 13.4, 13.5, 13.6 and 13.7.

B. Standards For Tests And Inspections...Tests and inspections called for in these Contract Documents not otherwise prescribed by law shall be in accordance with the standards set forth in the Specifications.

C. Factory And Field Operational Tests...Contractor shall be responsible and pay for all tests and inspections normally conducted by manufacturers and material suppliers and for any other tests or inspections which may be so specified herein. Contractor shall give timely notice, a minimum of one (1) week, to Engineer and Owner so that attendance can be arranged. No inspection, test, or approval shall be construed to relieve Contractor from his obligation to perform the work in accordance with the Contract Documents. Contractor shall verify performance of all equipment or materials by submitting certified copies of all tests and inspections on industry standard forms or on forms approved by the Engineer as prescribed in these General Requirements, Section 1D, 1.8.

D. Final Acceptance Testing...Contractor shall be responsible for and pay for supervising and conducting the acceptance tests of all equipment which shall be made in the presence of the Engineer and duly qualified representatives of the Owner. The time and procedure of such test shall be coordinated with and agreed upon by Engineer and Owner. Testing shall continue until all equipment items and interfacing items function properly as specified in these contract documents. After completion of the final acceptance tests, the Contractor shall submit the tests and inspection forms to Engineer who shall prepare the results and recommendations as to the acceptability of the equipment and materials, and submit them to Owner for review.

E. Inspectors...Engineer shall appoint qualified inspectors to ascertain the work is accomplished properly and in accordance with the Contract Documents. Whether in the field or in Contractor’s shop or shops of his subcontractors, the inspectors shall have full access to the work and shall be given full cooperation. The Inspector is authorized to take direct action upon results determined by tests or visual observance, communicating through the Contractor’s superintendent or foreman, and reporting immediately thereafter to the resident project representative. The inspectors shall have the authority, subject to the final decision of Engineer, to reject any defective work or material or to suspend the work if not being performed in accordance with the contract documents. The Inspector shall have no authority to permit any deviation from the contract documents except on written order from Engineer.

F. Testing Laboratory...Engineer shall provide qualified personnel and an adequate testing laboratory to perform testing of earthwork, concrete, and other similar items of work to determine the quality of work done and materials furnished. The field and laboratory technicians shall be responsible to the resident project representative and Engineer. All tests shall be performed in accordance with the applicable ASTM, AASHTO,
UBC, AWS, AWWA, etc. Standards, and Contractor shall hold Engineer and Owner harmless for any delays due to the performance of these tests.

G. Survey.....Engineer shall perform all boundary surveys and establish all base lines and major control points for locating the principal component parts of the work together with a suitable number of bench marks to enable Contractor to proceed with the work. The Engineer shall be responsible for establishing centerlines of structures. Initial slope stakes for major excavations, structures, and road embankment shall also be the responsibility of the Engineer. Contractor shall be responsible for giving timely notice and coordination of the above mentioned surveys, at least 48 hours in advance of the proposed activity. All other surveys needed for construction shall be the responsibility of the Contractor. Contractor shall be responsible for any and all costs of surveying to reestablish any of these boundaries or reference points disturbed or destroyed through his own negligence or faulty actions. Any of the Contractor's surveys may be verified by the Engineer at the Engineer's discretion. If the Engineer finds an error in the Contractor's survey, the Contractor shall be responsible for all the costs incurred by the Engineer to correct the error. The Engineer shall be responsible for surveys to establish measurement of monthly pay quantities. A copy of all Contractor field survey notes shall be submitted to the Engineer. All surveying shall be performed under the supervision of a Wyoming licensed Surveyor and survey notes submitted to the Engineer shall bear his signature.

1.2 DEFECTIVE WORK

A. Defective.....An adjective defined in the General Conditions, Article 1, describing unsatisfactory, nonconforming, faulty work as determined by testing and inspection.

B. Disapproval.....any defective work or material shall be disapproved or rejected by Engineer at any time before final acceptance even though it may have been overlooked and included in a previous monthly billing as approved by Engineer.

C. Samples And Costs.....Contractor shall furnish samples of questionable materials and/or equipment from completed work for testing purposes when required by Engineer. All costs in connection with the testing of the material or equipment proven defective shall be paid by Contractor or the amount thereof deducted from the contract price. If such tests prove the materials or equipment to be acceptable, their costs shall be paid by Owner.

D. Notice Of Defect.....Prompt notice shall be given by Engineer to Contractor of all defects as they become evident.

1.3 UNCOVERING WORK

Uncovering of work shall be as prescribed in the General Conditions, Articles 13.8 and 13.9.
1.4 ACCEPTANCE OF DEFECTIVE WORK

Owner may elect to accept defective work as prescribed in the General Conditions, Article 13.13. In so doing, Owner may request a reduction in price. The price reduction shall be based on the Engineer's evaluation of the serviceability of the item.

End Of Section
SECTION 1F - PERMITS

1.1 GENERAL

The Contractor shall familiarize himself with the conditions and requirements of all permits. The Contractor shall comply with the conditions and requirements of the permits in the performance of this contract. Failure to comply with the conditions and requirements of the permits may result in fines and/or suspension of work by the regulating agency and/or withholding of contract monies by the Owner. The Contractor shall also comply with other sections of the Contract Documents regarding environmental quality preservation.

1.2 OWNER SUPPLIED PERMITS

A. The Owner shall furnish and assign to the Contractor the following permits:

1. 404 Permit - U.S. Army Corps of Engineers.
2. BLM Easement - Bureau of Land Management.
3. 401 Permit - Wyoming Department of Environmental Quality
4. NPDES Permit - for the downstream cofferdam only - Wyoming Department of Environmental Quality.
5. Permit to Construct Sediment Retention Ponds - for downstream cofferdam only - Wyoming Department of Environmental Quality.
6. Permit to Construct Reservoir - for downstream cofferdam - State Engineer.
7. SPCC (Spill Prevention Control and Counter Measure) Plan - EPA

The Contractor shall comply with the SPCC Plan (Spill Prevention Control and Countermeasure) as attached in herein. The Contractor shall post a copy of the SPCC plan at the construction site. The Contractor shall designate specific field personnel responsible to implement the SPCC plan in the event of a spill and furnish names, addresses, and telephone numbers for these individuals to the Owner.

[INSERT COPY OF PERMITS HERE]

B. The Owner shall supply the above permits and the Owner shall transfer the permits to the Contractor's name prior to construction. The Contractor shall be legally bound to uphold all provisions of each permit. The Contractor shall be solely liable for any and all violations thereof and all fines or penalties resulting from said violations.

1.3 CONTRACTOR SUPPLIED PERMITS

A. The Contractor shall furnish the following permits:
1. Permit to Construct Sediment Retention Ponds - Pursuant to Chapter III of the Wyoming Water Quality Rules and Regulations, this permit shall be obtained from the Wyoming DEQ (WQD) prior to constructing sediment ponds to maintain discharge water quality below construction areas within applicable water quality standards. This permit applies to ponds that discharge and for ponds which won't discharge.

2. Land Application Permit - Pursuant to Chapter III of the Wyoming Water Quality Rules and Regulations, this permit shall be obtained from the Wyoming DEQ (WQD) prior to constructing sprinkling type or other types of land application systems to maintain water quality below construction areas within applicable water quality standards.

3. Mining Permit - Pursuant to Chapters II and XX of the Wyoming DEQ (LQD) Rules and Regulations, this permit shall be obtained from the Wyoming DEQ (LQD) prior to establishing borrow areas outside the reservoir area (below elevation 6698).

4. Solid Waste Disposal Permit - Pursuant to the Wyoming Solid Waste Managements Rules and Regulations, a Type III solid waste disposal permit shall be obtained from the Wyoming DEQ (LQD) prior to construction.

5. Burn Permit - Pursuant to the Wyoming Air Quality Standards and Regulations, this permit shall be obtained from the Wyoming DEQ (AQD) prior to construction. All burning shall also be in accordance with Federal, State, and local laws.

6. Fugitive Dust Permit - Pursuant to the Wyoming Air Quality Standards and Regulations, this permit shall be obtained from the Wyoming DEQ (AQD) prior to construction.

7. Temporary Construction Water Permits - Pursuant to Chapter IV of the Regulations and Instructions, State Engineer's Office, State of Wyoming, Part 1 - Surface Water, a temporary construction water permit shall be obtained for each construction water source from the State Engineer prior to construction.

8. Haul Road Permits - As required by the Wyoming State Highway Department and the Natrona and Converse County Governments.

9. Construction and Building Permits - As required by State and Local laws.

10. Any other permits not herein specified that may be required pursuant to any local, State of Wyoming, or Federal laws and regulations.
SECTION 1G - MATERIALS AND EQUIPMENT

1.1 ORDER, ARRANGEMENT, AND INSTALLATION

The materials and equipment installed in the work shall meet the requirements of the Contract Documents, and no materials or equipment shall be ordered until the item(s) submittals are reviewed by Engineer. All materials and equipment not otherwise specifically indicated shall be furnished by Contractor. Contractor shall guarantee that all materials and equipment he provides are in accordance with the specifications.

A. Space Requirements.....It shall be the responsibility of Contractor to coordinate and insure all materials and equipment to be furnished fit the space available. Contractor shall make all necessary field measurements to ascertain space requirements and directional location, including those for connections, and shall order such sizes and shapes of the materials and equipment so the final installation shall suit the intent and scope of the Contract Documents.

B. Arrangement.....Where equipment requiring different arrangement of connections from those shown is approved, it shall be the responsibility of Contractor to coordinate and install the equipment to operate properly, and as intended by the Contract Documents. All extra work and materials costs for needed modification shall be assumed by the Contractor.

C. Unacceptable Materials And Equipment.....Materials and equipment which do not conform to the requirements of the Contract Documents, are not equal to samples reviewed by Engineer, or are in any way unsatisfactory or unsuited to the purpose for which they are intended, shall not be furnished or installed.

D. Manufacturers' Directions.....Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as recommended by the manufacturer.

E. Modification For Installation.....Contractor shall do all necessary cutting and patching of existing work that may be required to properly receive the work of the various trades or as required by the Contract Documents to complete the installation. Contractor shall restore all such cut(s) or patched work as approved by Engineer. Any cutting of existing structure(s) that may endanger the work or adjacent property of the public shall not be done.

1.2 SHIPMENT OF MATERIALS AND EQUIPMENT

A. Preparation.....Contractor shall require manufacturers and suppliers to prepare equipment and materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage. Provisions for protection shall include the following:

1. Covers.....Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in hydraulic and electric motors and equipment.
2. Rust Prevention....Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
3. Lubrication....Grease packing or oil lubrication in all bearings and similar items.

B. Marking.....Each item of equipment and material shall be tagged or marked as identified in the delivery schedule or on compliance submittals, and complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked.

C. Availability Of Lands.....Coordinate delivery of materials with construction program so an undue amount of storage space is not required. Unloading, storage, and working space for the Contractor's use shall be as designated by the Engineer, and shall be as close to the work as practicable.

1.3 STORAGE OF EQUIPMENT AND MATERIALS

A. General....Due to mandatory winter shutdown periods, the Contractor shall be required to maintain both offsite and onsite storage facilities.

B. Onsite Temporary Storage Facilities.....Contractor shall provide all temporary buildings or trailers needed for storage of equipment and materials installed under this contract which requires indoor storage at the site prior to their installation. Onsite temporary storage facilities shall be approved by the Engineer.

C. Offsite Storage Facilities.....Contractor shall provide bonded and insured offsite storage facilities approved by Engineer and Owner, for storage of noninstalled materials and equipment during but not limited to the winter shutdown period. Contractor shall be responsible for all cost of the storage facility, insurance, and approval visitation of Engineer's and Owner's representative. Owner shall be made beneficiary of said bond and insurance. Partial payment of equipment and materials stored in offsite facilities shall be made in accordance with the General Requirements, Section 1C, 1.4 after Engineer has received certified materials receipt forms from Contractor indicating receipt of said equipment and materials.

D. Protection.....Contractor shall be responsible for the protection of all equipment and materials during the storage period in accordance with the manufacturer's or supplier's recommendations including the following:

1. Protection of motors, conditioners, electrical equipment, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter;
2. Protection of exposed machined surfaces and unpainted iron and steel with rust-preventive compounds;
3. Protection of bearings and similar items with grease packing or oil lubrication;
4. Handling and storage of steel plate, sheet metal work, fabricated metal work, and similar items in a manner to prevent deformation;
5. Storage of concrete aggregates so as not to become segregated and/or contaminated; and
6. Protection of cement either in bulk or sacks from freezing and moisture contamination.

E. Effects Of Storage.....Equipment and materials shall not show any pitting, rust, decay, or other deleterious and degrading effects of storage prior to final acceptance of work.

F. Protection Of Installed Materials And Equipment.....Contractor shall provide for the security and protection of installed materials and equipment as set forth in these contract documents. He shall provide protection at all times against rain, wind, storms, freezing, condensation, dust, or heat so as to maintain all work, equipment, and materials free from injury or damage. Partial pay requests for such materials shall be withheld until such time that these items of protection have been accomplished. Any damage to the work, equipment, or materials shall be reported immediately to Engineer and Contractor’s insurer.

1.4 RECEIPT AND UNLOADING OF EQUIPMENT AND MATERIALS

A. Inspection By Contractor.....Materials and supplies to be installed under this Agreement shall be received, unloaded, checked, inventoried, and stored by Contractor. Contractor shall report any damage to Engineer and advise Engineer of any shortages at time of delivery. Contractor shall furnish Engineer a "Certified Material Received" form for each shipment or lot of material received which will include the following information:

1. Specific material received;
2. Quantity received;
3. Date received;
4. Any damage (description and extent); and
5. Location material is stored on site.

b. Payment Of Charges And Claims.....The Contractor shall pay all delay and damage charges and claims resulting from unloading operations.

C. Contractor’s Representative.....The Contractor shall provide a representative located at the onsite and offsite storage facilities to receive, check, and store the materials shipped. This representative must be at the sites each day a shipment arrives.

End of Section
SECTION 1H - PROJECT CLOSEOUT

1.1 CLEANUP

Before final acceptance all grounds occupied by Contractor in connection with the work shall be cleaned of all rubbish. Excess material shall be landscaped, temporary structures and equipment shall be dismantled, and all parts of the work are to be left in an acceptable condition to be approved by Engineer.

1.2 GUARANTEES, BONDS, AND AFFIDAVITS

After Contractor has remedied all deficiencies to the satisfaction of Engineer and delivered all construction records, maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, certificates of compliance, and other documents -- all as required by the Supplementary Conditions, Section 14.8 -- Owner and Contractor will be promptly notified in writing that the work is acceptable subject to the provisions set forth under the following forms of which the Contractor will submit five (5) completed sets each:

- Certificate of Completion
- Certificate of Contractor
- Waiver and Release of Lien

1.3 FINAL INSPECTION AND ACCEPTANCE

A. Written Notice....When he considers the work ready for full occupancy or utilization by Owner, Contractor shall declare in writing to Owner and Engineer that the work is substantially complete and request that Engineer perform a final inspection.

B. Final Inspection....If all construction provided for as specified by the Agreement is found completed to Owner's and Engineer's satisfaction, that inspection shall constitute the final inspection, and Engineer will make the final acceptance and notify Contractor in writing of this acceptance as of the date of final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, Engineer will give Contractor the necessary instruction in writing for completion and corrections.

C. Acceptance Date....When Owner and Engineer have made the final inspection or another final inspection subsequent to correction of deficiencies from previous inspections, Engineer will notify Contractor and Owner in writing of this acceptance as of the date of final inspection.

This date of acceptance will fix the responsibilities between Owner and Contractor for Owner to assume the operation, heat, utilities, and normal maintenance. Assumption of the operation, heat, utilities, and normal maintenance does in no way release Contractor from the responsibility for providing final Contract Documents; unrevealed defects; omissions or errors; or as regards Owner’s rights under any warranty or guarantee.
D. Access.....Owner shall have the right to exclude Contractor from substantially completed work after the acceptance date, but Owner will allow Contractor access to complete or correct items on the defective list.

End Of Section
SECTION 11 - TEMPORARY FACILITIES AND CONTROLS

1.1 UTILITIES

-------

A. Telephone.....Contractor shall make all necessary arrangements and obtain and pay for installation of telephone for Contractor’s and Engineer’s offices. Monthly service billing shall be the responsibility of each respective office.

B. Electricity.....The Owner shall be responsible for making all necessary arrangements, coordination and installation of the power line from existing Pacific Power & Light Facilities into the project area. The primary power line shall be terminated at a point (meter pole) that is mutually agreeable to the Owner and Pacific Power & Light. It shall be the Contractor’s responsibility for installing power from the primary power terminal (meter pole) for the Contractor’s and Engineer’s offices. This shall include all necessary distribution lines, distribution circuits, transformers, and other electrical equipment required for distributing the power to the place or places of use by the Contractor. Until such time as permanent power is available, Contractor shall provide, operate, and maintain generator facilities to provide adequate electrical power.

At the termination of the contract under these specifications, the Contractor shall dismantle and remove all distribution lines serving his installations, or those of his subcontractors, that are not part of the permanent power installation.

No direct payment shall be made to the Contractor for providing electric power for construction purposes, and the cost thereof shall be included in the prices bid in the schedule for other items of work.

C. Natural Gas.....will not be available on the project site.

D. Heat –

1. Contractor shall provide the necessary heat systems for Engineer’s and Contractor’s offices.

2. Contractor shall provide cold-weather protection and temporary heat when ambient temperature falls below 40 degrees fahrenheit as required to protect all work, equipment, and materials against injury from dampness and cold, or to provide proper conditions for the installation and curing of materials.

3. Method of heating and fuel shall be suitable for the particular purpose. Combustion-type heaters shall be properly vented.

E. Potable Water.....The Contractor shall provide fresh, sanitary drinking water for Contractor’s and Engineer’s Staff. Water may be hauled in properly maintained water tanks from municipal services, or Contractor may drill a well, with proper approval and permits, and supply a distribution service to provide potable drinking water. Any method and system must comply with the requirements of the state and local regulatory bodies and meet approval of Owner and Engineer.
F. Sanitary Provisions....The Contractor shall provide and maintain in a
neat, sanitary condition such self-contained accommodations for the use
of his employees and the Engineer's staff as may be necessary to comply
with the requirements of the State and local boards of health, or of
other bodies or tribunals having jurisdiction.

1.2 FIELD OFFICES AND SHEDS

A. Contractor's Field Office....Contractor shall provide his own field of­
office for Contractor's superintendent and staff.

B. Engineer's Field Office.....Contractor shall be responsible for pro­
viding separate office space for the Engineer and his staff. The office
space shall be separate from the Contractor's office facility and shall
consist of three structures. Engineer's two office facilities shall
contain a minimum of 720 square feet each. One structure shall have an
area large enough to be used for meetings and one private office and the
other structure shall have three private offices. The other office
shall be used as a field laboratory and contain a minimum of 520 square
feet. Each office shall have the utilities stated in Subsection 1.1 A,
B, D, E, and F, of this section. The Engineer's two office facilities
shall be furnished as approved by the Engineer.

C. Temporary Buildings Erected By Contractor.....Contractor may erect
temporary buildings on the job site for such purposes as offices, ware­
housing, craft change rooms, and fabrication shops. The location and
design of these buildings will be approved by the Engineer.

Trailers or semitrailers parked by Contractors on the job site shall be
subject to Engineer's approval as to type and condition. Dilapidated
trailers and semitrailers are prohibited. No utilities are permitted in
semitrailers. Contractor's trailers and semitrailers shall be located
in an area approved by the Engineer.

Upon completion of the Contractor's work, any temporary buildings must
be removed including any concrete slabs or any underground utilities in­
stalled by the Contractor.

1.3 PROJECT IDENTIFICATION

Project identification signs shall be furnished and installed by the
Contractor at the locations directed by the Owner. The signs shall con­
form to the requirements specified in Section 2M. All Contractor signs
shall be placed in appropriate locations where they will not obstruct
traffic or construction operations. They shall be removed upon comple­
tion of the work. All signs shall be approved by the Engineer before
erection.

1.4 FREIGHT SERVICE

A. Commercial Trucking....At the time that these Specifications were
prepared there were several licensed interstate commerical highway
carriers servicing the Casper-Glenrock area: ANR Freight System, Inc.;
CNW Transportation Co.; Consolidated Freightways; Edson Express;
Nebraska Transport Co.; North Park Transportation Co.; NW Transport
Service; and Yellow Freight System.

B. Railroad Service.....The Burlington Northern Railroad and the Chicago and North Western Railroad service the Casper-Glenrock area.

C. Contractor’s Representative.....Contractor shall provide a representative at the delivery sites to receive, check, and store the materials shipped. This representative must be at the site each day a shipment arrives.

1.5 ROADS

Access into the Deer Creek Dam area is very limited. Wyoming State Highway 253 (Hat Six Road), a paved secondary, begins at Interstate 25 six miles southeast of Casper and runs approximately 10 miles southeasterly toward the project area. Natrona County Road 606, a gravel surfaced road, connects with Wyoming 253 and runs southeasterly toward the project approximately another 5 miles. Approximately 4 miles of unimproved ranch road connect with Natrona 606 and runs southeasterly to the project area. Converse County Road 19, a paved road, begins in Glenrock and runs approximately 8 miles southeasterly toward the project area. Converse 19 connects with Converse County Road 20, a gravel surfaced road, which continues southeasterly approximately another 3 miles toward the project. Converse 20 connects with approximately 5 miles of unimproved ranch trail which connects with Natrona County Road 606 approximately 2 miles before Natrona 606 runs into the unimproved ranch road previously mentioned above. Mileages sited herein and in the following sections are approximate and are for information only, Contractor is responsible to verify actual mileages.

A. Designated Haul Road -

The Owner specifies that the designated haul road shall be Wyoming Highway 253 which turns into Natrona County Road 606, which turns into an unimproved ranch road. The above route runs from I-25 near Casper, Wyoming to the Deer Creek Dam Area.

The Contractor shall be responsible for maintaining this designated haul road for the Contractor’s and the public’s use throughout the duration of this Agreement from the I-25 Interchange to the project area. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment, materials, forces, traffic control devices, and safety to the end that the roadway is kept in satisfactory condition for the accommodation of two lanes of traffic.

The maintenance on the designated haul road shall be performed on all of the designated road from the I-25 Interchange to the Deer Creek Dam construction area, which includes approximately 10 miles of asphalt surfacing of at least 22 feet in width, approximately 5 miles of all weather gravel dirt road of at least 30 feet in width, and approximately 4 miles of unimproved ranch road. The maintained travel surface shall be an approved surface which allows two lanes of traffic without hazards or restrictions caused by, but not limited to, potholes, rutting, corrugations, soft spots, and excessive mud or dust.
If the Contractor at any time fails to comply with the provisions of this section, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Owner may immediately proceed to maintain the project, and the entire cost of this maintenance will be deducted from monies due or to become due the Contractor.

All cost of maintenance work during the duration of this contract and before the contract is accepted shall be as directed by the Owner per Section 2JJ of the Specifications.

B. Winter Mainenance Of Roads -

Snow removal on Wyoming 253 is performed by the Wyoming Highway Department per their priority system for snow removal in the Casper area. Snow removal on Natrona County Road 606 is performed by Natrona County on an as-needed basis. There is no snow removal on the unimproved ranch road. It shall be the Contractor's responsibility to maintain the designated haul road from the southeasterly end of Natrona County Road 606 to the project area as directed by the Owner per Section 2JJ of the Specifications.

C. Maintaining Public Traffic.....The Contractor shall make all necessary provisions for the maintenance of public traffic and shall conduct his operations so as to offer the least possible obstruction and inconvenience to public traffic. All traffic control devices and operations dealing with public traffic and roadways will be in accordance with applicable Wyoming laws and the manual on Uniform Traffic Control Devices for Streets and Highways.

Convenient access to driveways, houses, and buildings along the line of the work shall be maintained, and temporary approaches to crossings or intersecting roads shall be provided and kept in good condition. The Contractor shall provide and station competent flagmen whose sole duties shall consist of directing and controlling the movement of public traffic around the work.

At any and all points along the work where the nature of the construction operations in progress and the equipment and machinery in use are of such character as to endanger passing traffic, the Contractor shall provide such guards as may be necessary to insure against accidents and avoid damage or injury to passing traffic.

The cost of all work involved in providing for maintenance of public traffic, as set forth in this section, shall be in accordance with Section 2HH of the Specifications.

1.6 EXPLOSIVES, DRILLING, AND BLASTING

A. Explosives....The transportation, handling, storage, and use of explosives shall be subject to the provisions of Subpart U -- Blasting and the Use of Explosives -- of the Department of Labor "Safety and Health Regulations for Construction" and the regulations of the Bureau of Alcohol, Tobacco and Firearms contained in 27 CFR 55, Commerce In Ex-
The Contractor shall maintain an inventory record of storage and withdrawal of all explosives. This record shall be available to the Engineer, and he shall be promptly notified of any loss or theft of explosives. The Contractor shall provide such reasonable and adequate protective facilities as are necessary to prevent loss or theft of explosives. Overnight storage of explosives and detonators outside of the magazines will not be permitted.

B. Drilling Dust Control. When drilling in rock or other dust-producing material, the dust shall be controlled within safe hygienic limits as specified in the "Threshold Limit Values of Airborne Contaminates" published by the American Conference of Governmental Industrial Hygienists.

C. Percussion Drilling. All percussion-type drilling shall be performed with drilling apparatus equipped with water or chemical dust-control systems or other equivalent means of controlling the dust. Pressure tanks used in the suppression equipment shall conform to ASME Boiler and Pressure Vessel Code, Section VIII, for unfired pressure vessels. Equipment and solutions shall be suitable for operation in freezing weather. Except for underground excavation, dust-control devices are not required on jackhammers provided the operators wear approved-type dust respirators when dust concentrations exceed safe hygienic limits.

D. Blasting. Blasting will be permitted only after adequate provision has been made for the protection of persons, the work, and public or private property. Approval by the Owner or his representatives of any of the Contractor's blasting operations shall not relieve the Contractor of his responsibility for the safety of persons or property. Damage to the work or to public or private property by blasting shall be repaired by and at the expense of the Contractor.

E. Vibration And Damage Control. Blasting in or adjacent to cofferdams, buildings, dwellings, structures, or other facilities shall be carefully planned and controlled to eliminate possibility of damage to such facilities and structures. When appropriate, the Owner may require the Contractor to submit a controlled blasting plan which incorporates provision for monitoring blasts with an approved-type blasting seismograph.

1.7 WATER FOR CONSTRUCTION PURPOSES

A. Description. This work shall consist of the furnishing of water from designated sources and the application of water to soil, aggregates, concrete, grouting, or for the control of dust, or for other purposes as directed by the Engineer.

Water is available at a rate of at least 500 gpm from Deer Creek within the job site. The Contractor shall make arrangements for obtaining necessary permits and payment of fees and royalties.

B. Application. Water shall be added to materials designated by any of the following applicable methods.

1. Prewetting. Contractor may apply water to the undisturbed material of
Zone 1, Zone 4, or Zone 5 borrow excavation operations.

The Contractor shall submit for approval to Engineer a detailed plan of method and equipment showing the proposed location of lines and sprinklers and the amount and rate of application. Such plans shall be based on soil classification and in place moisture. The Contractor shall maintain an adequate mechanical drill on the job to recover representative samples and upon completion of watering shall determine the depth of penetration.

Unstripped prewet areas shall be stripped as soon as possible after the required water has been applied to the area.

2. Water Added At Mixing Plants.....When aggregate or cementing materials are blended at a central mixing plant, water shall be metered with the flow of the material into the mixer.

3. Water Added By Distributor Trucks.....Deficiencies in moisture content of Zone 1, Zone 4, or Zone 5 embankment materials and aggregate surfacing shall be corrected by the addition of water, and water for dust control, finishing operations, and seeding shall be applied by approved distribution equipment.

Water shall be distributed in such a manner by means of controllable pressure and spray bar or nozzles that will avoid ponding or overwetting materials.

1.8 SITE SECURITY AND RESTRICTIONS

Contractor shall be responsible for the work area and storage area security. Contractor may elect to make arrangements with the Converse County Sheriff's Office and Commissioners, or place enclosure fence around the work site or any portion of the storage and fuel areas, or employ a work site watchman. The Owner shall not be responsible for any damage or loss.

1.9 FIRE PROTECTION AND EQUIPMENT

Contractor shall provide and maintain fire protection equipment, personnel, and programs conforming to standards of Federal, State, and local laws and regulations. Contractor shall be responsible for all fires in the immediate confines of the project limits and any fire which may be started by the Contractor's activities adjacent to project lands.

All cost for providing equipment, personnel, and programs for fire protection shall not be paid for directly and should be distributed over the other project bid items.

1.10 AID STATION AND AMBULANCE

Contractor shall maintain an adequate aid station, and provide a certified E.M.T. (Emergency Medical Technician) and ambulance at the work site during all work hours. All first aid equipment shall conform to the applicable safety standards of Federal, State, and local laws and regulations. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. He shall take all necessary precautions for the
safety of and shall provide the necessary protection to prevent damage, injury, or loss of all employees on the work and other persons who may be affected thereby. The Contractor and his subcontractors shall submit to the Owner their safety policies and procedure to which they will adhere at all times.

All costs for providing and maintaining such personnel, equipment, and programs shall not be paid for directly, but should be distributed over the other project bid items.

End Of Section
SECTION 1J - ENVIRONMENTAL QUALITY PROTECTION

1.1 LANDSCAPE PRESERVATION

A. General. The Contractor shall exercise care to preserve the natural landscape beyond the defined areas of work and shall conduct his construction operations so as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Except where clearing is required for permanent works, all trees, native shrubbery, and vegetation shall be preserved and shall be protected from damage which may be caused by the Contractor's construction operations and equipment. Movement of crews and equipment within the project area and over routes provided for access to the work shall be performed in a manner to prevent damage to the land.

B. Construction Roads. The location, alignment, and grade of construction roads shall be subject to approval of the Owner.

When no longer required by the Contractor, construction roads above elevation 6698 within the reservoir and all other areas shall be obliterated by removing all fill material and smoothing cutbanks to conform to natural contours. The topsoil shall be obtained from the stockpiled topsoil from required excavation; provided, that no payment shall be made for placing topsoil to obliterate construction roads, and all costs therefor shall be included in the prices bid on the schedule for other items of work, unless specified differently in other sections of the Specifications.

C. Construction Facilities. The Contractor's shop, office, and yard area shall be located and arranged in a manner to preserve trees and vegetation to the maximum practicable extent. On abandonment, all storage and construction buildings, including concrete footings and slabs, and all construction materials and debris shall be removed from the site. The area shall be left in a neat and natural appearing condition.

D. Borrow Areas. Borrow pits shall be so excavated that water will not collect and stand therein. Before being abandoned, the sides of borrow pits shall be brought to stable slopes with slope intersections rounded and shaped, to provide a natural appearance. All rubbish, Contractor's equipment, and structures shall be removed from the site. Waste piles shall be leveled and trimmed to regular lines and shaped to provide a neat appearance. Where directed by the Engineer, topsoil shall be placed in denuded portions of the borrow areas above elevation 6710.

E. Blasting Precautions. In addition to the requirements of Section 1J, 1.6, the Contractor shall adopt precautions when using explosives which will prevent scattering of rocks, stumps, or other debris outside the work area.

F. Measurement And Payment. Except otherwise provided for placing topsoil, the cost of all work required by this subsection shall be included in the prices bid in the schedule for other items of work.

1J-1
1.2 PRESERVATION OF TREES

A. Preservation....All trees and shrubbery which are not specifically required to be cleared or removed for construction purposes shall be preserved and shall be protected from any damage that may be caused by the Contractor's construction operations and equipment. The removal of trees or shrubs will be permitted only after prior approval by the Owner.

The layout of the Contractor's construction plant, location of access and haul routes, and operations in borrow and spoil areas shall be planned and conducted in such manner that all trees not approved for removal by the Owner shall be preserved and adequately protected from either direct or indirect damage by the Contractor's operations. The Contractor's facilities, such as shops, warehouses, storage areas, and parking areas shall be located and arranged in such manner that removal of trees and shrubs will be the minimum practicable as approved by the Owner.

Special care shall be exercised where trees or shrubs are exposed to injuries by construction equipment, blasting, excavating, dumping, chemical damage, or other operations; and the Contractor shall adequately protect such trees by use of protective barriers or other methods approved by the Owner.

Except in emergency cases trees shall not be used for anchorages. Where such use is approved, the trunk shall be wrapped with a sufficient thickness of burlap or other approved material over which softwood cleats shall be tied before any rope, cable, or wire is placed. Failure to protect trees and shrubs through negligence or disregard may result in fines by the appropriate regulatory agency or the withholding of contract monies.

B. Restoration of Damage....The Contractor shall be responsible for injuries to trees and shrubs beyond the defined areas caused by his operations. The term "injury" shall include, without limitation, bruising, scarring, tearing, and breaking of roots, trunk, or branches. All injured trees and shrubs shall be repaired or restored as nearly as practicable without delay to their original condition at the Contractor's expense. The Owner will determine the method of repair, treatment, or restoration to be used for injured trees and shrubs as recommended by an experienced horticulturist or tree surgeon provided by and at the expense of the Contractor. All repairs, treatment, or restoration of injured trees shall be performed under the direction of a licensed tree surgeon provided by and at the expense of the Contractor. Repairs shall include shaping of wounds, sealing of wounds or cuts, and removal of damaged limbs. Scars or wounds shall be sealed with an approved tree dressing. Where tree climbing is necessary, the use of climbing spurs will not be permitted, and climbing ropes will be required where determined necessary for safety.

Trees or shrubs that are beyond saving shall be removed and replaced early in the next planting season with the same species or other approved species, and of the maximum size that is practicable to plant and sustain growth in the particular environment. Replaced trees and shrubs shall be watered and maintained for a period of one (1) year, and the
trees shall be guyed. Any newly planted tree or shrub that dies shall be removed and replaced with such replacements being maintained for a period of one (1) year from the date of replacement.

C. Measurement And Payment. The costs of all work required by this subsection shall be included in the prices bid in the schedule for other items of work.

1.3 PREVENTION OF WATER POLLUTION

A. General. The Contractor's construction activities shall be performed by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, and other objectionable pollutants and wastes into streams, flowing or dry watercourses, and underground water sources. Such pollutants and wastes include, but are not restricted to, refuse, garbage, bentonite, cement, concrete, sewage effluent, industrial waste, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution. Sanitary wastes shall be disposed of on land by burial at approved sites or by other approved methods as required by issuance of permit by State Agency and local regulations.

Dewatering work for foundations, or earthwork operations adjacent to, or encroaching on, streams or watercourses shall be conducted in a manner to prevent muddy water and eroded materials from entering the streams or watercourses by construction of intercepting ditches, bypass channels, barriers, settling ponds, or other approved means. Excavated materials or other construction materials shall not be stockpiled or deposited near or on streambanks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff or can in any way encroach upon the actual watercourse itself.

Turbidity increases in a stream or other bodies of water that are caused by construction activities shall be limited to the increases above the natural turbidities permitted under the State Water Quality Standards prescribed for that stream or body of water. The Contractor shall be solely responsible for insuring that water quality standards are maintained within the limits permitted by State Water Quality Standards.

Waste waters from construction operations shall not enter streams, watercourses, or other surface waters without the use of such turbidity control methods such as settling ponds, gravel-filter entrapment dikes, approved flocculating processes that are not harmful to fish, recirculation systems for washing of aggregates, or other methods that will prevent the water from exceeding State Water Quality standards. Any such waste waters discharged into surface waters shall be essentially free of settleable material.

Discharge into streams from treatment facilities shall only be from permitted point discharge sources under the NPDES Permit. The only permitted point discharge source is the downstream cofferdam. The Contractor is responsible to secure any additional NPDES discharge points. Instead, the Contractor should consider "non-discharge" treatment processes such as land treatment (sprinkling) and/or routing potential streamflow sources around disturbed areas.

1J-3
The Contractor shall also comply with the occupational health and environmental controls set forth in Subpart D of The Department Of Labor "Safety And Health Regulations For Construction".

At least thirty (30) days prior to beginning construction, the Contractor shall submit for approval two (2) copies of his plans for prevention of water pollution which may result from his operations. The plans shall be submitted to the Owner. Such plans shall also show the methods of handling and disposal of oils or other petroleum products, chemicals, and similar industrial wastes.

Review of the Contractor's plans shall not relieve the Contractor of responsibility for designing, constructing, operating, and maintaining pollution control features in a safe and systematic manner, and for repairing at his expense any damage to, or failure of, the pollution control structures and equipment caused by floods or storm runoff. The water pollution control plan shall be updated on an as needed basis.

B. Compliance With Laws And Regulations.....The Contractor shall comply with applicable Federal and State laws, orders, and regulations concerning the control and abatement of water pollution.

The Contractor shall also comply with the sanitation requirements of Subpart D, Occupational Health And Environmental Controls, of The Department Of Labor "Safety And Health Regulations For Construction".

C. Measurement And Payment.....The costs of complying with this subsection shall be included in the prices bid in the schedule for the various items of work.

1.4 ABATEMENT OF AIR POLLUTION

The Contractor shall comply with applicable Federal, State, and local laws and regulations concerning the prevention and control of air pollution.

In conduct of construction activities and operation of equipment, the Contractor shall utilize such practicable methods and devices as are reasonably available to control, prevent, and otherwise minimize atmospheric emissions or discharges of air contaminants.

Equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustments, or other inefficient operating conditions, shall not be operated until corrective repairs or adjustments are made.

Burning of materials resulting from clearing of trees and brush, combustible construction materials, and rubbish will be permitted only when atmospheric conditions for burning are considered favorable and when authorized by appropriate State or local air pollution or fire authorities. The Contractor shall notify the Owner at least 24 hours in advance of a planned major burn. The Contractor shall also notify the Casper Federal Aviation Administration of any planned major burns. In lieu of burning, such combustible materials may be removed from the site or buried. Where open burning is permitted, the burn piles shall be
properly constructed to minimize smoke, and in no case shall unapproved materials, such as tires, plastics, rubber products, asphalt products, or other materials that create heavy black smoke or nuisance odors, be burned.

Storage and handling of flammable and combustible materials, provisions for fire prevention, and control of dust resulting from drilling operations shall be in accordance with the applicable provisions of the Department of Labor "Safety And Health Regulations For Construction" and the Bureau Of Reclamation Supplement thereto.

Dust nuisance resulting from construction activities shall be prevented in accordance with Subsection 1.5 of this section.

The costs of complying with this subsection shall be included in the prices bid in the schedule for the various items of work.

1.5 DUST ABATEMENT

During the performance of the work required by these Contract Documents or any operations appurtenant thereto, the Contractor shall furnish all the labor, equipment, materials, and means required, and shall carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, orchards, cultivated fields, and dwellings, or causing a nuisance to persons. The Contractor will be held liable for any damage resulting from dust originating from his operations under these specifications.

The cost of sprinkling or of other methods of reducing formation of dust shall be included in the prices bid in the schedule for other items of work.

1.6 PRESERVATION OF HISTORICAL AND ARCHAEOLOGICAL DATA

A. Public Law 93-291...p.l. 93-291, May 24, 1974, provides for the preservation of scientific, prehistorical, historical, and archaeological data (including relics and specimens) which might otherwise be lost due to alteration of the terrain as a result of any Federal construction project.

B. Schedule...Several archeological sites are located below the high water line of the proposed reservoir (elevation 6698) and along the project access roads. Several of these sites have been mitigated and construction may proceed within these areas. The area of the dam and spillway site and reservoir borrow areas have been mitigated and construction may proceed, without delay. Portions of the reservoir area have not been mitigated (see Drawings). The Contractor shall plan his reservoir clearing schedule and construction activities to account for this fact within his bid, for additional details refer to Section 2B. Prior to commencement of work in any new areas, Contractor shall contact Owner for approval in order not to disturb any unmitigated archeological site.
C. Notification Of Owner.....The Contractor agrees that should he, any of his employees, or subcontractors in the performance of this contract encounter the remains of prehistoric animals and people, people's dwelling sites, or artifacts of possible scientific, historical, or archaeological significance, the operations in the area of the find shall be temporarily discontinued, and he will notify the Owner immediately.

Whenever field conditions exist that dictate the involvement of an archaeologist, the Contractor is to notify the Owner's field manager and the State Archaeologist immediately, and explain the conditions found with such notification confirmed by letter.

The Owner will then arrange for the site to be evaluated by a representative of the State Archaeologist which may involve excavation and, if necessary, site preservation. The Owner shall direct a letter to the Contractor, with copies to each of the parties contacted, confirming and documenting the actions taken.

D. Delays, Changes.....The Owner may direct modification to the schedule or sequence of the Contractor's work to permit evaluation of the archaeological find. When directed by the Owner and under the State Archaeologist's supervision, the Contractor may be required to excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for the custody of the State Archaeologist. If such excavation, delays, and/or charges are ordered, the time of performance and/or contract price shall be adjusted in accordance with the applicable clauses in this contract.

E. Subcontracts.....The Contractor agrees to insert these paragraphs in all subcontracts which involve the performance of work on the terrain of the site.

1.7 PESTICIDES

Pesticides include herbicides, insecticides, fungicides, and rodenticides. Should the Contractor find it necessary to use pesticides in work areas of this Agreement, he shall submit his plan for such use to the Owner for written approval.

Pesticides shall be only those registered with the Environmental Protection Agency in compliance with the Federal Environmental Pesticide Control Act of 1972, and other Federal pesticide acts. Pesticides named on the Department of Interior's "Prohibited List" shall not be used.

1.8 CLEANUP AND DISPOSAL OF WASTE MATERIAL

A. Cleanup.....The Contractor shall at all times keep the construction area, including storage areas used by him, free from accumulations of waste materials or rubbish.

Prior to completion of the work, the Contractor shall remove from the vicinity of the work all plant facilities, buildings, rubbish, unused materials, concrete forms, and other like material, belonging to him or used under his direction during construction. All work areas shall be graded and left in a neat manner conforming to the natural appearance of
the landscape as provided in Section 1K, 1.1.

Expense of cleanup, if performed by the Owner, will be for the account of the Contractor, and, if necessary, the surety. Final payment will not be made until site is clear.

B. Disposal Of Waste Materials

1. General.....Waste materials including, but not restricted to, refuse, garbage, sanitary wastes, industrial wastes, and oil and other petroleum products, shall be disposed of by the Contractor. Disposal of combustible materials shall be by burying, where burial of such materials is approved by the Owner; by burning, where burning of such materials is permitted in accordance with State and local laws; or by removal from the construction area. Except as otherwise provided in these Specifications, disposal of noncombustible materials shall be by burying, where burial of such materials is approved by the Owner, or by removal from the construction area. Waste materials removed from the construction area shall be dumped at an approved dump. Disposal of waste material in all instances will be in compliance with State and local laws.

2. Disposal of Material By Burying.....Only materials approved by the Owner may be buried. Burial shall be in pits at locations approved by the Owner. The pits shall be covered by at least two (2) feet of earth material prior to abandonment.

3. Disposal of Material By Burning.....The Contractor shall secure the necessary burning permits from the State and local authorities. All burning shall be in accordance with State and local laws.

All materials to be burned shall be piled in designated burning areas in such manner as will cause the least fire hazard. Burning shall be thorough and complete, and all charred pieces remaining after burning, except for scattered small pieces, shall be removed from the construction area and disposed of as otherwise provided in this paragraph.

4. Public Landfill.....Contractor shall not dispose of waste in any publicly-owned sanitary landfill, including, but not limited to, the sanitary landfill operated by any town or village without first obtaining written verification from appropriate public officials that the proposed use of the public sanitary landfill by Contractor is satisfactory. A copy of this written verification shall be provided to Owner prior to use of the landfill.

End of Section
SECTION 1K - LIQUIDATED DAMAGES

1.1 GENERAL

Time shall be of the essence of this contract on the part of the Contractor, and it is hereby agreed by the parties hereto that in case all of the work called for under said agreement, in all parts and requirements, is not completed by and at the key dates herein specified or by such other time to which the period of completion may be extended, damages will be sustained by the State of Wyoming Water Development Commission in the potential loss of water and in additional costs for project administration and other engineering services.

1.2 DAMAGES

Any and all damages incurred by the State of Wyoming Water Development Commission attributable to the delay of completion and start-up of this agreement will be assessed the Contractor. Damages shall include any and all costs incurred by delay of completion of the project. The specific damages and means of computation and assessment shall be as stipulated herein.

The construction of the Deer Creek Dam Project shall be completed on, or before ________. Failure to meet the completion date may result in the Owner's inability to store and subsequently market water from Deer Creek Reservoir. The Owner will also suffer the expenses to reimburse Engineer and Owner's Representative for their billings and expenses. The estimated daily liquidated damage for delay (but not as a penalty) shall not exceed $3,500 for each day that expires after the specified completion date.

1.3 PENALTIES

The damages shall be deducted from the amount due or to become due the Contractor, and such payments or deductions shall not in any degree release the Contractor from further obligations and penalties in respect to the fulfillment of the entire agreement or any right which the commission may have to claim, sue for, or recover as compensation and damages for nonperformance of this agreement.

End of Section
SECTION 1L - HYDROLOGIC DATA

1.1 GENERAL

This Section presents tabular estimated streamflow data for the proposed Deer Creek Reservoir site. In addition, a graphical presentation of this data and estimated hydrographs of the 5-year, 10-year, 25-year, and 100-year runoff events are presented in the Drawings.

Graphical and tabular presentations of estimated streamflow data were developed by statistical correlation with historic streamflow data for Deer Creek at Glenrock (USGS Gaging Station No. 06646500), Deer Creek below Millar wasteway, at Glenrock (USGS Gaging Station No. 06646600), and Deer Creek in Canyon, near Glenrock (USGS Gaging Station No. 06646000). Storm runoff hydrographs were estimated from historic floods of record and adjusted Log Pearson-Type III analysis of the annual peak flood of Deer Creek at Glenrock for 56 years of record.

Neither the Owner nor the Engineer guarantees the correctness of the hydrologic presentations shown in these specifications, on the Drawings, or in reports and other documents, nor any interpretations, deductions, or conclusions shown on any drawings, reports, or other documents relative to hydrologic conditions. Each Bidder must form his own opinion of the hydrologic character of the streams; he must make his own interpretations, and satisfy himself by his own investigations and research regarding all conditions affecting the work to be performed. Bidders and Contractors must assume all responsibility for deductions and conclusions as to the nature or condition of all streams, ditches, and other water courses, the difficulties of making and maintaining temporary diversions or other means required for doing other work affected by the hydrology of the project areas.

End Of Section
ESTIMATED INFLOW (CFS) TO DEER CREEK RESERVOIR
(Statisically correlated to USGS Gaging stations 06646000, 06646500, 06646600)
YEAR

OCT

NOV

DEC

JAN

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

ANNUAL
TOTAL

PCT OF
AV ANN

******************************************************************************~****************************************************

......

t-4
I

N

1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983

10.90
14.15
7.81
16.75
6.18
11. 87
4.23
1.63
2.76
6.18
7.97
10.41
22.12
0.98
17.73
11.71
4.07
6.51
12.36
14.64
8.94
5.04
6.34
6.99
13.50
6.18
8.62
1. 30
3.90
1. 46
16.43
1. 79
10.41
2.93
8.78
10.90
5.37
3. 90
37.57
6.34
8.62
11.71
8.46
8.94
19.35
27.97
16.75
12.69
11. 22
9.92
12.20
6.51
9.92
4.55
8.46
26.51

20.33
18.32
14.96
13.44
8.23
12.10
11.26
3.53
7.39
10.25
11.76
12.44
10.08
2.69
18.65
15.46
8.40
8.23
13.44
11. 60
10.25
8.40
7.39
9.08
10.42
5.38
13.28
3.70
14.79
4.71
20.17
3.70
10.76
3.53
10.42
11. 09
7.73
4.87
17.98
7.90
10.92
12.77
10.08
9.24
12.94
28.07
16.81
12.60
11. 26
9.92
12.44
6.72
10.08
4.20
8.23
26.72

11. 38
16.26
18.05
13.50
10.25
7.64
15.78
11.38
6.99
5.04
10.73
10.25
8.94
4.07
16.59
20.49
4.88
7.48
11.38
7.48
10,41
7.97
5.37
6.83
9.60
8.46
14.15
7.97
20.17
5.53
16.10
3.74
13.50
4.23
10.57
11.55
4.23
6.02
19.84
6.18
12.03
11.06
7.16
9.60
12.03
26.02
15.45
11. 87
10.57
9.11
11.38
6.02
9.27
4.07
7.64
24.72

11. 06
13. 50
11.71
13.50
10.25
8.46
17.08
7.97
5.53
4.55
14.96
7.48
10.08
4.07
15.29
17.08
6.34
7.97
9.92
5.04
9.43
6.99
4.55
4.55
8.78
9.43
18.38
7.97
16.26
4.88
14.15
7.32
12.03
5.53
9.76
7.48
4.88
6.34
15.78
7.16
10.41
12. 03
7.16
13.17
11. 22
24.56
14.64
11.06
10.08
8.78
10.73
5.69
8.62
3.74
7.32
23.09

10.62
14.94
19.27
14.76
23.41
8.46
19.45
3.96
4.32
6.30
8.10
5.76
12.78
3.24
13.14
18.73
10.44
8.28
10.98
3. 42
9.36
10.98
5.58
5.58
9.72
9.54
20.89
8.82
13.14
6.66
16.39
8.28
15.31
6.48
17.11
10.44
4.68
7.02
14.40
8.10
14.22
12.60
9.72
13.68
12.24
26.65
16.21
12.24
10.80
9.36
11. 52
6.30
9.36
4.14
8.10
25.21

38.71
72.53
15.94
18.05
28.79
29.76
19.03
5.53
10.57
12.52
31.39
23.42
13.99
8.13
13.66
38.54
12.52
13.50
37.89
47.00
12.69
23.42
9.76
12.36
11. 55
17.89
48.95
16.43
31. 55
11. 06
24. 72
11. 22
74.49
11. 22
20.33
31.71
8.78
6.99
37.89
28.30
23.42
13. 34
13. 01
24.72
51.39
20.65
58.55
22.12
35.45
18.70
17.56
18.38
17.24
9.27
8.78
68.47

94.11 254.52
207.04 522.06
194.10 233.38
139.82 271.44
220.32 431.79
263.18 648.10
126.88
58.71
18.15 311.61
127.39
92.86
102.35 230.62
243.01 263.47
213.77 181.01
97.30 183.29
231.41 460.25
240.99 635.57
167.05 113.03
102.01 532.95
79.66 456.19
145.70 327.71
202.84 228.34
146.54 179.22
203.85 296.16
177.30 226.39
112.77 213.70
148.23 322.34
74.62 287.21
157.80
71. 72
133.27 149.79
42.77
21. 34
40.00 284.61
133.10 236.63
81. 00 169.30
98.07
138.65
48.23 122.14
223.01 266.88
59.49
75.46
166.38 531.33
46.55 534. 09
166.21 120.19
36.64 240.86
180.32 385.44
148.56 112.05
126.38 641. 92
181.67 693.80
127.55 377.80
159.99 1051.27
359.64 368.37
89.07 300.06
108.40 313.56
229.06 248.02
34.79 495.22
98.82 175.16
184.69 295.34
9.08 172.88
5.71 291.11
288.38 583.53

AVERAGE

10.03

11.09

10.70

10.10

11.27

24.35

140.43

310.92

77.81
127.89
47.06
68.06
27.73
117.30
10.42
156.63
9.24
218.30
33.61
10.76
14.96
51. 93
52.94
63.02
64.70
205.36
115.62
170.41
29.24
63.36
84.70
44.87
44.03
63.86
21. 01
84.70
21. 85
98.65
19.16
21. 01
18.82
41.17
94.95
137.13
135.45
163.01
6.72
212.42
212.76
83.52
533.58
199.15
85.71
161.33
61.84
230.40
106.88
9.58
65.54
37.98
18.15
27.23
90.58
393.59

11.71
8.29
4.72
4.55
1.95
4.72
3.09
7.64
1.79
50.42
11.22
2.28
5.04
13.99
5.53
9.43
29.92
27.32
18.70
57.41
6.02
9.11
11.06
12.69
9.11
5.20
6.34
11.06
6.67
12.52
12.69
12.52
12.20
8.29
15.12
20.98
18.54
19.19
2.60
84.57
17.73
21.31
21.63
16.59
8.29
19.68
15.94
15.12
16.59
6.02
6.34
6.18
2.60
5.04
19.03
36.10

4.23
7.48
6.02
4.23
2.28
2.60
1.14
1.14
0.33
8.94
1.95
3.58
1.14
9.92
2.28
1. 79
3.74
21.14
5.85
8.94
2.93
2.93
2.93
3.58
3.09
3.74
6.51
5.20
3.90
6.34
4.55
3.09
6.34
3.42
7.16
7.32
3.90
7.81
1.95
7.32
5.37
2.44
5.85
4.39
3.09
13.99
4.72
6.51
4. 39
2.76
8.62
4.07
0.49
2.76
6.51
8.62

4.71
10.42
6.39
5.04
3.36
5.04
1. 34
1.18
1.34
17.98
2.69
1.18
0.50
13.28
4.37
0.50
2.02
8.40
8.23
7.56
3.03
4.37
4.54
3.03
2.52
3.03
2.35
2.02
3.36
5.55
1.01
1. 85
3.19
4.54
5.21
6.05
3.70
14.79
1.01
7.06
5.55
3.70
4.20
10.08
9.24
18.65
8.23
3.36
2.86
4.20
1.68
2.02
0.50
1. 85
12.10
5.21

550.09
1032.89
579.39
583.16
774.53
1119.23
288.40
530.34
270.53
673.46
640.87
482.32
380.23
803.95
1036.74
476.83
782.00
850.05
717.81
764.69
428.07
642.58
545.91
436.02
592.88
494.54
390.00
432.22
199.71
481.97
515.09
324.82
413.76
261.71
689.30
389.61
894.96
820.59
442.14
652.84
886.80
445.10
1389.14
1185.04
730.88
1578.83
957.14
727.11
642.07
565.43
688.03
373.83
566.28
248.81
473.58
1510.16

95.85

14.47

4.95

5.02

649.19

84.7
159.1
89.2
89.8
119.3
172.4
44.4
81.7
41.7
103.7
98.7
74.3
58.6
123.8
159.7
73.5
120.5
130.9
110.6
117.8
65.9
99.0
84.1
67.2
91.3
76.2
60.1
66.6
30.8
74.2
79.3
50.0
63.7
40.3
106.2
60.0
137.9
126.4
68.1
100.6
136.6
68.6
214.0
182.5
112.6
243.2
147.4
112.0
98.9
87.1
106.0
57.6
87.2
38.3
73.0
232.6


SECTION 2A - TEMPORARY ENVIRONMENTAL PROTECTION MEASURES AT THE DAM SITE AND DIVERSION AND CARE OF DEER CREEK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....This section includes all temporary environmental protection measures carried out in the immediate dam construction area, including the inundated reservoir area, and all areas upstream of the dam construction area that are used by the Contractor. This area is as shown on the Drawings. These environmental protection measures include, but are not limited to; temporary cofferdams, dikes, bridges, straw bales, sedimentation control fabric, conduits, culverts, levee banks, flumes, channels, drains, pumps, settling ponds, and any other temporary measures necessary to ensure the required water quality. This section also includes all work required to affect the diversion, maintain the required streamflows, maintain the required water quality standards, divert and/or regulate the streamflows through the 2-24" diameter steel pipes, and all care and diversion of the stream during tunnel closures and until the reservoir water surface level exceeds elevation 6500 and all streamflows are able to be passed through the completed outlet works. Included in this section is an Owner approved log boom and/or trashrack placed upstream of the diversion tunnel inlet portal. Also, included in this section is the removal and disposal of the downstream cofferdam, reclamation of the river from the diversion tunnel outlet portal upstream to and including the stream bed adjacent to the control building, and placing rockfill to prevent access at the diversion tunnel outlet portal.

B. Related Work Described Elsewhere.....Permits shall be as specified in Section 1F. Environmental quality protection shall be as specified in Section 1J. Pertinent hydrologic data is described in Section 1L. The embankment material for the upstream and downstream cofferdams as shown on the Drawings shall be as specified in Section 2F. The outlet works for the upstream and downstream cofferdams shall be as specified in Section 2L. The 2-24" diameter steel pipes within the diversion tunnel shall be as specified in Section 10K. The 24-inch gate valves installed in the diversion tunnel shall be as specified in Section 10J.

1.2 RESPONSIBILITY

A. All temporary environmental protection measures, diversion and care of Deer Creek and its tributaries in the project area, maintenance of required streamflows of Deer Creek, and meeting the required water quality standards are the responsibility of the Contractor. The Contractor shall be responsible for any additional incurred expenses due to any damage or delay in the work caused by failure of any of his temporary environmental protection measures or his diversion works.

B. It is the sole responsibility of the Contractor to comply with all of the requirements of the permits dealing with temporary environmental protection and diversion and care of Deer Creek.
C. Hydrologic data on Deer Creek, diversion tunnel discharge curves, outlet works discharge curves, and the reservoir capacity curves are shown on Sheet A-7 of the Drawings. This data is shown solely as an aid to the Contractor. Diversion and temporary environmental protection measures remain the sole responsibility of the Contractor, and the Owner and Engineer assume no responsibility in the Contractor's interpretation and use of this data.

1.3 DIVERSION SEQUENCE

A. This diversion sequence is offered as one option the Contractor can use. The Contractor shall submit to the Owner, in writing, a detailed diversion sequence and plan for acceptance no less than 30 days prior to commencing the tunnel excavation operations. The Contractor shall receive no payment for tunnel excavation work completed until he has obtained an Owner approved diversion sequence and plan. The Contractor has the option to modify the suggested diversion sequence and plan in his submittal for acceptance by the Owner and at no additional cost to the Owner.

B. Excavate entire 14' diameter modified horseshoe tunnel, installing portal protection, steel ribs, wood blocking, channel lagging, and any other required elements as shown on the drawings, or called out in the specifications. Install the 2-24" diameter steel pipes, including the upstream and downstream gate valves, as shown on the drawings.

C. Divert the stream into the diversion tunnel and construct the upper and lower cofferdams.

1. Note that the 1-24" diameter pipe with upstream valve is installed as shown on the drawings of the upstream cofferdam. This pipe is installed to allow filling of the reservoir area between the dam and the upstream cofferdam, and is not designed to allow diversion through the cofferdam during its construction or prior to completion of the diversion works.

2. The outlet works in the downstream cofferdam is designed to retain run-off from the construction area. The water shall be retained until the quality of the water meets required standards, and then discharged. It may be necessary to treat the water of solids before it is released. It shall be the responsibility of the Contractor to control the quality of the water being discharged from the downstream cofferdam.

D. Divert the stream into the 2-24" diameter steel pipes, and install the tunnel lining in that portion of the diversion tunnel that coincides with the outlet works tunnel.

1. Note that the capacity of the 2-24" diameter steel pipes is less than 50 CPS and the Contractor should be aware that the possibility exists of a required discharge greater than the capacity of the pipes, thereby flooding ongoing tunnel lining operations.

E. Upon substantial completion of the tunnel lining in that portion of the diversion tunnel that coincides with the outlet works, the stream can then be diverted from the 2-24" diameter steel pipes into the 10'
diameter steel lined tunnel and back into the 14' diameter modified horseshoe tunnel for the remainder of the dam construction operations.

1. The Contractor shall take all precautions necessary to prevent any water from entering those portions of the outlet works tunnel upstream from the upstream closure area, and downstream from the downstream closure area. If not already completed, tunnel liner operations may continue in these areas.

F. Upon substantial completion of all dam construction, the stream will again be diverted into the 2-24" diameter steel pipes to construct the upstream (O.W. Sta. 1+25) and downstream (O.W. Sta. 8+76) closures of the outlet works tunnel. The Contractor is again alerted to the limited capacity (50CFS) of the 2-24" diameter steel pipes. Prior to the completion of closure, the stream channel and disturbed areas between the outlet works control building and temporary downstream diversion tunnel shall be reclaimed. The downstream cofferdam shall be removed and the material disposed of at designated waste areas. The outlet portal of the diversion tunnel shall be filled with rock to prevent access into tunnel.

G. Upon completion of the upstream and the downstream closures, the streamflows shall be pumped to the intake sill elevation (6500) and routed through the completed outlet works. At this time, the gate valves in the 2-24" diameter steel pipes shall be closed and sealed as shown on the Drawings. After the gate valves have been sealed, streamflows in excess of the required discharge shall be stored in the reservoir area.

H. When the water level in the reservoir reaches elevation 6500, pumping operations shall cease, and all discharges shall be controlled through the completed outlet works.

1.4 DIVERSION AND CARE OF SURFACE WATER

A. The Contractor shall take all measures necessary to prevent surface run-off from entering the construction area including the design, construction, and maintenance of all temporary protection items. These items shall include, but not necessarily be limited to; cofferdams, levee banks, channels, dikes, bridges, stream bales, sedimentation control fabric, culverts, flumes, drains, pumps, and settling ponds.

B. When no longer required, all temporary protection items shall be removed, levelled, or returned to the original grade as approved by the Owner.

1.5 POLLUTION

A. Water quality is the responsibility of the Contractor. The Contractor shall, by whatever means necessary, prevent discharge of any polluting substance into Deer Creek from the entire construction area while maintaining minimum streamflows. All water discharged into Deer Creek shall meet the required water quality standards.
1.6 DEWATERING OF EXCAVATIONS AND FOUNDATIONS DURING CONSTRUCTION

A. The Contractor shall be responsible for all dewatering of excavations and foundations within the dam construction area. This shall include discharging of the water from the dewatering areas to a permitted settling area prior to discharging, through a permitted discharge point, into Deer Creek. The Contractor shall be responsible and ensure that all water from any dewatering operation discharged into Deer Creek comply with the permitted water quality requirements.

The only permitted discharge point is through the outlet of the downstream cofferdam. The Contractor is responsible to permit other discharge points and design the required facilities to meet Wyoming DEQ requirements. It is highly recommended that instead of treating and discharging, the Contractor dispose of waste water by land application or other means so not to discharge into receiving waters of the State.

1.7 DEWATERING OF CONSTRUCTED EMBANKMENT

A. During construction of the concrete face of the dam, and upon completion of the concrete face prior to reservoir filling, the Contractor shall ensure that no resultant uplift pressure occurs under the completed concrete face slab. The Contractor shall provide to the Owner, in writing, a proposal to prevent these uplift pressures. This proposal shall be submitted to the Owner for approval not less than 30 days prior to commencement of placing concrete in the plinth. The Contractor shall obtain written approval of a submitted proposal for preventing uplift pressures under the concrete face slab prior to any payment for plinth construction.

PART 2 - PRODUCTS

2.1 GENERAL

A. No products, as such, are listed in this section of the specifications. It is, however, the responsibility of the Contractor to supply all products necessary to comply with this section of the specifications. The Contractor shall submit product information with his proposals as required in Part 1.3, 1.4, and 1.7 of this Section (2A) of these Specifications. The outlet works for the upstream and downstream cofferdams shall be as specified in Section 2L. The 24" diameter steel pipe in the diversion tunnel shall be as specified in Section 10K. The 24-inch gate valves shall be as specified in Section 10J.

B. All products used for temporary environmental protection measures within the dam area and for diversion and care of Deer Creek during construction shall be furnished by the Contractor with the approval of the Owner.
PART 3 - EXECUTION

3.1 GENERAL

A. Detailed plans, methods, and sequences as provided for in this specification shall be submitted by the Contractor, in writing, for the written approval of the Owner. These plans, methods, and sequences shall comply with the environmental quality requirements as dictated within the Owner obtained permits.

3.2 TESTING

The Contractor is responsible for all water quality monitoring and testing.

A. The Contractor shall make and submit to the Owner all environmental quality tests as required by the permits.

End of Section
SECTION 2B - CLEARING AND GRUBBING

PART 1 - GENERAL

A. The work in this section shall consist of providing all labor, material, and equipment required for clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of the permanent construction area for the dam site, spillway, outlet works, permanent access roads, boat ramp, borrow areas, stockpile areas, cofferdam sites, and waste areas as shown on the Drawings. Suitable vegetable matter shall be conserved as mulch and incorporated into topsoil in accordance with Section 2N of the Specifications.

B. The work in this section shall also consist of providing all labor, material, and equipment required for clearing the reservoir below elevation 6703 minus the areas mentioned in paragraph 1.1-A of this section and for clearing between the dam site and the spillway of all vegetation and debris.

C. The work in this section shall also include all labor, material, and equipment required for the preservation from injury or defacement of all vegetation and objects designated to remain.

D. The Owner shall establish clearing and grubbing lines and clearing only lines and shall designate all tree, shrub, and plant areas to remain. The Contractor shall preserve all things designated to remain. Materials from clearing and grubbing and clearing only may, at the Contractor's option pursuant to Section 1P of the General Requirements, be buried, burned, chipped, or removed from the site of the work before the date of final completion.

E. Clearing and grubbing of the dam and spillway construction area shall not commence until after diversion through the diversion tunnel is made and the downstream cofferdam has been constructed. Clearing and grubbing can only be done in areas which have received clearance from SHPO (State Historical Preservation Officer). Archeological sites within the reservoir area will be mitigated and clearance from SHPO sought during the course of this Agreement. Therefore, the following clearing, and clearing and grubbing schedule for the dam and reservoir areas shall be included in the Contractor's scheduling of work:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Anticipated Earliest Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing, Clearing and Grubbing of Dam, Spillway, and Intake Areas</td>
<td>After Diversion</td>
</tr>
<tr>
<td>Clearing and Grubbing of designated borrow areas in the reservoir</td>
<td>19 [year 1]</td>
</tr>
<tr>
<td>Clearing of Reservoir Area in SE 1/4 Section 11, SW1/4 Section 12, W1/2 Section 13 (excluding archeological sites 48C01143 and 48C01145), E1/2 Section 14</td>
<td>19 [year 2]</td>
</tr>
</tbody>
</table>
The Contractor shall not proceed with any clearing and grubbing activity on this Project without first receiving the approval of the Owner to ensure that previously identified archeological sites are not disturbed.

PART 2 - PRODUCTS

No Products

PART 3 - EXECUTION

3.1 CLEARING

A. This work shall consist of clearing all trees, stumps, and brush 5 feet or more in height, regardless of diameter; clearing all trees, stumps, and brush 2 inches or more in diameter, regardless of height; clearing all down timber, branches and other floatable and combustible material 5 feet or more in length, regardless of diameter; clearing all down timber, branches and other floatable and combustible material 2 inches or more in diameter, regardless of length; and clearing all fence posts, fences, buildings, and bridges within the reservoir area below elevation 6703, on the left abutment within the area between the dam site and the spillway, and within the permanent construction areas for the dam site, spillway, outlet works, cofferdam sites, and permanent access roads as shown in the Drawings.

B. Trees and stumps shall be either uprooted or cut off so that the maximum allowable stump height shall be 6 inches as measured on the uphill side of the stump. Brush shall be cut off approximately flush with the ground.

C. No trees, stumps or brush shall be cut outside of the area mentioned above and as shown in the Drawings without written approval of the Owner.

D. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed. Branches of trees extending over roadbeds shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

3.2 GRUBBING

This work shall consist of grubbing all trees, stumps, roots, brush, organic matter, and other protruding obstructions in toto within the permanent construction areas for the dam site, spillway, outlet works, permanent access roads, boat ramp, borrow areas, cofferdam sites, and stockpile areas as shown on the Drawings.
3.3 PRESERVATION OF TREES, BRUSH, AND VEGETATION

All trees, brush, and vegetation which are not specifically required to be cleared or removed for permanent construction purposes shall be preserved and shall be protected from any damage that may be caused by the Contractor's construction operations and equipment. The Contractor shall adequately protect such trees, brush and vegetation by use of protective barriers or other methods approved by the Owner. Preservation of trees, brush, and vegetation shall be subsidiary to grubbing.

3.4 RESTORATION OF DAMAGE

The Contractor shall be responsible for injuries to trees, brush, and vegetation beyond the defined areas caused by his operations. The term "injury" shall include, without limitation, bruising, scarring, tearing, and breaking of roots, trunk, or branches. All injured trees and shrubs shall be repaired or restored as nearly as practicable without delay. Repairs shall include shaping of wounds, sealing of wounds or cuts, and removal of damaged limbs. Scars or wounds shall be sealed with an approved tree dressing.

Trees or brush that, in the opinion of the Owner, are beyond saving shall be removed and replaced early in the next planting season with the same species or other approved species, and of the maximum size that is practicable to plant and sustain growth. Trees and brush shall be watered and maintained for a period of 1 year, and the trees shall be guyed as necessary. Any newly planted tree or brush that dies shall be removed and replaced as directed, with such replacements being maintained for a period of 1 year from the date of replacement. Restoration of damage shall be subsidiary to grubbing.

3.5 DISPOSAL OF MATERIAL

The Contractor may, at no cost, retain any materials of value from clearing operations for his own use or disposal by sale. Such material shall be removed from the construction area before the date of completion of the work under the Specifications. Trees retained by the Contractor shall be limbed and piled neatly within designated storage areas. Every reasonable effort shall be made by the Contractor to channel materials into beneficial use. The Owner assumes no responsibility for the protection or safekeeping of any material so retained by the Contractor.

Materials disposed of by burying shall be buried at locations designated on the Drawings and/or approved by the Owner and shall be covered with not less than 2 feet of earth material. Approved locations shall be natural or excavated depressions in the reservoir area which are not subject to erosion from streamflow or wave action.

If perishable material is burned, the Contractor shall secure the necessary burning permits from State and local authorities prior to burning. Burning shall be under the constant care of competent watchmen and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain within the construction area.
will not be jeopardized. Burning shall be thorough and complete. All charred pieces remaining after burning shall be buried in compliance with the previous paragraph.

On easements through private property, the Contractor shall not burn on the site unless specifically permitted in writing by the property owner. In all cases, the authority to burn shall not relieve the Contractor in any way from damages which may result from his operations. In no case shall any material be left on the project, shoved onto abutting private properties, or be buried in embankments or trenches on the project.

Materials and debris which cannot be burned and perishable materials may be removed from the right-of-way and disposed of at approved locations off the project outside the limits of view from the project with the written permission of the property owner upon whose property the materials and debris are placed. Copies of all agreements with property owners shall be furnished to the Owner. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations, and the cost involved shall be included in the unit price bid.

End of Section
SECTION 2C - EXCAVATION - OPEN CUT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work to be Performed.....This work shall consist of furnishing all equipment, materials, and manpower required and of performing all operations required to be performed in accordance with required excavation, including but not limited to excavation for the dam foundation, the plinth, the intake and outlet structures of the outlet works, the spillway, the road from the spillway to the dam, the borrow areas, the quarry areas, and the cofferdams, disposal of all undesirable and waste materials, and dewatering. The work shall also include cleaning of the excavation for the cofferdams, dam foundation, plinth, the intake and the outlet structures of the outlet works and spillway.

B. Shape of Excavation.....Required excavations for the dam and appurtenant works shall be performed in accordance with this Section and to the lines, grades, and dimensions shown on the Drawings. During progress of work, the Owner may find it necessary or desirable to vary slopes, grades, or dimensions of the excavations from those specified herein, and the Contractor shall not be entitled to any adjustment to the rates bid in the Schedule for excavation by reason of such changes. Any excess excavation for the convenience of the Contractor or overexcavation performed by the Contractor for any purpose or any reason, except as may be ordered in writing by the Owner, shall be at the expense of the Contractor. Where required to complete the work, all such excess excavation and overexcavation shall be refilled with materials approved by the Owner and furnished and placed at the expense of the Contractor.

C. Control of Blasting.....All blasting for excavations shall be subject to the provisions of this Section. All necessary precautions including control of blasting, shall be taken to preserve the material below and beyond the established lines of all excavation in the soundest possible condition.

Whenever, in the opinion of the Owner, further blasting might injure the material upon or against which concrete is to be placed, the use of explosives shall be limited to light loads, and the excavation shall be completed by light blasting, wedging, barring, channeling, line drilling and broaching, or other suitable methods approved by the Owner. Any damage to the work due to the Contractor's operation, including shattering of the material beyond the required excavation design lines, shall be repaired at the expense of and by the Contractor. Slopes shattered or loosened by blasting shall be taken down at the expense of and by the Contractor.

Blasting shall be done using lift (or bench) heights not greater than 24 feet and using blast holes having diameters not greater than 3 1/2 inches; provided, that as the excavation for structure foundations approaches the final excavation lines, the depths of the blast holes shall not exceed one-half of the depth of the rock remaining above the final grade; provided further, that the final 5 feet of rock to be
excavated for structure foundations shall be blasted and excavated as a separate operation.

Blasting in or adjacent to cofferdams, structures, or other facilities shall be carefully planned and controlled to eliminate possibility of damage to such facilities and structures. When blasting in or adjacent to those facilities, the Owner shall require the Contractor to submit a controlled blasting plan which incorporates provision for monitoring blasts with an approved-type blasting seismograph.

D. Wet and Frozen Materials....All excavation for embankment cutoff trenches and structure foundations shall be performed in the dry. No excavation shall be made in frozen materials without written approval of the Owner. No additional allowance above the unit prices per cubic yard bid in the Bid Schedule for excavation shall be made on account of any of the materials being frozen or wet.

1.2 QUALITY ASSURANCE

Excavations in open cuts shall be made to the lines, grades, and dimensions shown on the Drawings or as established by the Owner. The work will be done in a workmanlike manner meeting the lines, grades, and dimensions set.

1.3 GEOLOGIC CONDITIONS

The geologic conditions for the dam and reservoir portion of the project are discussed in detail in the geologic reports previously prepared by R.W. Beck and Associates in February, 1984, and Chen and Associates, Inc. in November 1984. In the area of the dam and appurtenant structures, the general geologic conditions consist of surficial soil deposits ranging from a few inches to approximately 10 feet in thickness overlying granite and granite gneiss bedrock. These same general conditions exist in the proposed quarry areas. The bedrock consists of complexly intermixed granite, granite (felsic) gneiss, and mafic and felsic intrusive rock which are usually hard, dense and strong. Fault breccias, shear zones and areas of altered rock are also present. The fault breccias and shear zones have the consistency of soil and contain clay materials. The altered rock varies from hard, dense and strong to soft and weak. The rock is complexly fractured and jointed. In the proposed borrow areas, the general geologic conditions consist of up to 30 feet of soils overlying granite and granite gneiss bedrock.

1.4 DEFINITIONS OF MATERIALS

Materials to be excavated will be classified for payment. For purposes of these Specifications, materials of earthwork and embankment construction are defined in detail as follows:

A. Rock.....A sound and solid mass, layer, or ledge of mineral matter in place and of such hardness and texture that it:

1. Mechanical Definition of Rock.....Cannot be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of
standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor rated between 210- and 240-net flywheel horsepower, operating in low gear, or

2. Manual Definition of Rock.....In areas where the use of the ripper described above is impracticable, rock is defined as sound material of such hardness and texture that it cannot be loosened or broken down with a 6-pound drifting pick. The drifting pick shall have a handle not less than 34 inches in length.

B. Common Material.....All earth materials that do not meet the requirements of rock as defined above.

C. Formation.....Any sedimentary, gneiss, or metamorphic material represented as a unit in geology, generally called rock but not necessarily meeting the classification requirements for rock in "A" above.

D. Cobbles.....Rounded pieces of rock which are not greater than 12 inches but are larger than 3 inches in maximum dimension.

E. Boulders.....Detached pieces of rock, generally rounded but may be subrounded to angular, which are larger than 12 inches in maximum dimension.

F. Rock Fragments.....Pieces of rock which are generally not rounded.

G. Soil Components.....Soils in nature usually consist of a number of soil components. They are identified by the predominance of one of the components and other criteria given in the Unified Soil Classification System.


2. Silt.....Non-plastic soil which passes the United States Standard No. 200 sieve.

3. Sand.....Mineral grains which pass the United States Standard No. 4 sieve and are retained on the United States Standard No. 200 sieve.

4. Gravel.....Pieces of rock which are not greater than 3 inches in maximum dimension, and are retained on the United States Standard No. 4 sieve.

H. Other Materials -

1. Talus.....Sand to boulder size angular fragments of granite.

2. Colluvium.....Silt, sand, gravel, and some cobbles.

1.5 EXCAVATED MATERIALS

As far as practicable, all suitable materials from excavations for specified permanent construction shall be used in the permanent construction required under these Specifications. Excavated materials
which are unsuitable for, or in excess of requirements for permanent
construction, as determined by the Owner, shall be wasted as provided in
Section 2G. The Contractor's blasting and other operations in
excavations shall be such that the excavations shall yield as much
suitable material for such construction as practicable, and shall be
subject to the approval of the Owner. Where practicable, suitable
materials shall be excavated separately from the materials to be wasted
and the suitable materials shall be segregated by loads during the
excavation operations. The suitable materials shall be placed in the
designated final locations directly from the excavation, or shall be
placed in temporary stockpiles and later placed in the designated
locations as directed by the Owner.

PART 2 - PRODUCTS
(No Products)

PART 3 - EXECUTION

3.1 EXCAVATION, COMMON

A. General....The Contractor shall carry out open-cut common excavation
for the dam foundation, the plinth, the intake and outlet structures for
the outlet works, the spillway, the road from the spillway to the dam,
the borrow areas, and the cofferdams, to the lines, grades and
dimensions shown on the Drawings or as directed by the Owner.

B. Classification of Common Excavation.....For purposes of payment, the
term "common excavation" is defined as including all material classified
as common under Part 1.4B of this Section of the Specifications
including, earth, gravel, and soft or disintegrated rock, which can be
removed sufficiently by excavation machinery and will loosen by ripping;
common excavation also includes all boulders or detached pieces of solid
rock not exceeding 1 cubic yard in volume.

C. Dam Foundation and Plinth.....Open cut common excavation for the dam
foundation area includes the removal of partially and completely
weathered material from the dam foundation, removal of materials which
might interfere with the proper bonding of the dam embankment with the
foundation or with the proper compacting of the dam embankment, and the
removal of materials of inadequate strength. The extent and depth of
the open cut excavation to reach a suitable foundation shall be as
determined by the Owner. The excavation shall include sufficient clean
up to enable the Owner to determine if further excavation is required.

D. Outlet Works and Spillway.....Open-cut common excavation for the intake
and outlet structures for the outlet works and the spillway includes the
removal of partially and completely weathered material for the
foundations for those structures. The extent and depth of the open cut
excavation to reach a suitable foundation shall be as determined by the
Owner. The excavation shall include sufficient clean up to enable the
Owner to determine if further excavation is required.

The bottom and side slopes of excavation upon or against which concrete
is to be placed shall be excavated to the required dimensions as shown
on the Drawings or as established by the Owner. No material shall be permitted to extend within the design lines of the structure. If the natural foundation soils are disturbed or loosened, they shall be removed and replaced with concrete.

The bottom and side slopes of common excavation material upon or against which concrete is to be placed shall be prepared by moistening and tampening or rolling with suitable tools and equipment to form a firm foundation for the concrete structure.

E. Borrow Areas....All materials required for the following construction which are not available from excavations required for permanent construction under these Specifications shall be obtained from the borrow areas: (1) construction of main dam embankment Zone 1; and (2) construction of cofferdam embankment Zones 1 and 5.

The locations of the borrow areas are shown on the Drawings. Explorations in the borrow areas indicate that the materials are variable in nature and texture and contain variable amounts of moisture and plus No. 4 material.

Groundwater levels encountered in the explorations, as shown on the logs, are for the indicated dates. The absence of a groundwater level or moisture content on any log of exploratory hole within the borrow areas does not, however, imply that groundwater or variable moisture contents will not be encountered in the vicinity of such explorations.

Contractor is cautioned that wide variation in the nature, texture, moisture content, and percentage of oversized material as indicated by the explorations, is to be anticipated. Contractor must assume all responsibility for deductions and conclusions concerning the nature, moisture content, and texture of materials, the percentage of oversized materials, the total yield of suitable materials, the difficulties of making excavations, of breaking down or removing the oversized materials, of obtaining a satisfactory moisture content, and of obtaining a uniform mixture of materials.

The location and extent of all borrow pits within borrow areas shall be as directed, and the Owner reserves the right to change the limits or locations of borrow pits within the limits of the borrow areas in order to obtain the most suitable material, to minimize stripping, or for other reasons.

To avoid the formation of pools in borrow pits during the excavation operations, drainage ditches from borrow pits shall be excavated by the Contractor where, in the opinion of the Owner, such drainage ditches are necessary. The water being removed from the borrow pits shall be disposed or diverted in accordance with the requirements of Section 1J of these Specifications.

Final excavated surfaces of borrow pits below the reservoir high water line shall be graded to slopes not steeper than 3:1. Other than as specified above, the Contractor shall not be required to excavate the surfaces of borrow pits to any specified lines and grades, but such surfaces shall be left in a reasonably smooth and even condition and
require trimming, as directed by the Owner, to provide a neat appearance or to provide suitable surfaces for seeding in the reservoir area above elevation 6703 or as directed by the Owner. Borrow pits shall be operated and left in a condition so as not to impair the usefulness or the appearance of any part of the work or any property of the Owner. The surfaces of wasted materials shall be left in a reasonably smooth and even condition.

F. Cofferdam Foundations.....Open cut common excavation for the cofferdam foundations includes the removal of loose, granular soil which might interfere with proper bonding of the cofferdam embankments with the foundation or the proper compacting of the cofferdam embankments and the removal of pervious materials. The extent and depth of the open cut excavations to reach suitable foundations shall be as determined by the Owner. The Owner shall direct the excavation in successive cuts until a suitable foundation is reached. The Contractor shall not be entitled to any additional allowance above the rate bid in the Bid Schedule for common excavation by reason of such successive stages in the excavation procedure. Each successive stage of excavation shall include sufficient cleanup to enable the Owner to determine if further excavation is required.

3.2 EXCAVATION, ROCK-DAM FOUNDATION AND PLINTH
-------------------------------------------
A. General.....Excavation in rock for dam foundation and plinth includes all required rock excavations to the lines, grades, and dimensions shown on the Drawings or directed by the Owner for the foundation of the dam including the plinth.

B. Classification of Rock Excavation.....For purposes of payment, the term "rock excavation" is defined as excavating the material defined as rock in Part 1.4A of this Section of the Specifications and includes all solid rock in-place which cannot be removed until loosened by blasting, barring, or wedging and all boulders or detached pieces of solid rock more than 1 cubic yard in volume.

C. Dam Foundation.....Excavations in rock for the dam foundation area includes the removal of weathered material from the dam foundation and the removal of materials which might interfere with the proper compacting of the dam embankment. The extent and depth of the excavation to reach a suitable foundation is shown on the Drawings but shall be determined by the Owner in the field. The Owner shall direct the excavation in successive cuts until a suitable foundation is reached. The Contractor will not be entitled to any additional allowance above the rate bid in the Schedule for excavation in rock for dam foundation by reason of such successive stages in the excavation procedure. Each successive stage of excavation shall include sufficient clean up to enable the Owner to determine if further excavation is required.

Excavation for the foundation of Rockfill Zones 3A and 3B of the dam embankment shall be made to sufficient depth to secure a foundation on reasonably fresh to moderate weathered rock.

Excavation for the foundation of Rockfill Zones 2 and 2A of the dam
embankment shall be made to the same depth as for the plinth.

D. First Stage Plinth Excavation.....The excavation for the plinth shall be carried out in two stages. The first stage excavation shall be made to the dimensions and elevations shown on the Drawings. If the foundation surface exposed by the first stage excavation is sound and fresh to slightly weathered rock, then the surface shall be surveyed in accordance with this part of the Specifications. If the foundation surface exposed by the first stage excavation is moderately to highly weathered rock, the foundation shall be inspected by the Owner who shall decide what additional rock excavation is required in the plinth area. The foundation shall be cleaned off with water, air, or other suitable means to allow the required inspections.

When the foundation surface has been accepted, it shall be surveyed by the Owner so that the plinth alignment can be evaluated and second stage excavation Drawings for the plinth prepared, if required.

E. Second Stage Plinth Excavation.....The objective of second stage excavation is to secure a foundation on acceptable rock, free as practicable from open or highly weathered seams, shattered zones and other defects. The foundation shall be cleaned off with water, air, or other suitable means to allow the required inspections before further excavation. In any area where the required standard of foundation is not achieved at the levels shown on the Drawings, the excavation shall be deepened locally until an acceptable foundation is obtained. The foundation shall be locally cleaned off with water, air, or other suitable means to allow the required inspections. Excavation shall not proceed beyond a level lower than 2 feet below that shown on the Drawings without the prior approval of the Owner.

Where the sound rock surface over an extensive area lies below the rock excavation levels shown on the Drawings, the plinth location shall be reviewed by the Owner and the plinth reference line relocated as required for the conditions encountered in the excavation.

F. Foundation Profile.....In the profile of the plinth foundation, abrupt nearly vertical steps of less than 2 feet in height will be acceptable. Steps greater than 2 feet shall be battered to a slope not steeper than 0.45 horizontal to 1 vertical. If necessary, plinth construction joints shall be relocated or additional joints provided, to suit the steps in the foundation profile.

Earth and loose rock adjacent to the plinth excavation shall be excavated to the steepest practicable slopes with due regard to safety during construction. Solid rock shall be excavated as closely as practicable to the lines shown on the Drawings or as approved by the Owner.

G. Blasting.....Every effort shall be made to ensure that the quantity and power of explosives used shall neither open seams, nor crack, nor damage the rock outside the prescribed limits of excavation. Whenever, in the opinion of the Owner, further blasting might injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation completed by wedging and barring or
other suitable methods.

The length of holes, the firing pattern and the charges shall be designed by a professional engineer working for and paid by the Contractor and a record shall be kept of all patterns and charges used in each excavation. One copy of the record shall be submitted to the Owner on a weekly basis.

Where shown on the Drawings and/or where directed by the Owner, slopes shall be line drilled or pre-split by a method approved by the Owner. The spacing of the line holes shall be sufficiently close to ensure that the rock breaks along the design lines.

H. Disposal of Materials.....So far as practicable, as determined by the Owner, all suitable materials from excavation in rock for dam foundation and plinth shall be used in the permanent construction required under these Specifications.

The Contractor's blasting and other operations in excavation shall be such that the excavation shall yield as much suitable material for construction as practicable, and shall be subject to the approval of the Owner. Where practicable, as determined by the Owner, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The suitable materials shall be placed in the designated final locations directly from the excavation, or shall be placed in temporary stockpiles and later placed in the designated locations as directed by the Owner.

I. Inspection.....Foundation surfaces shall not be covered with any material until they are inspected and approved in writing by the Owner. The Contractor shall give to the Owner at least 48 hours notice of the readiness of dam foundations for final inspection.

3.3 EXCAVATION, ROCK-OUTLET WORKS
-----------------------------
A. General.....Excavation in rock for the intake and outlet structures of the outlet works includes all rock excavations to the lines, grades, and dimensions shown on the Drawings or as directed by the Owner for the foundation of the intake and outlet structures for the outlet works.

B. Classification of Rock Excavation.....For purposes of payment, the term "rock excavation" is defined as excavating the material defined as rock in Part 1.4A of this Section of the Specifications and includes all solid rock in-place which cannot be removed until loosened by blasting, barring, or wedging and all boulders are detached pieces of solid rock more than 1 cubic yard in volume.

C. Blasting.....Every effort shall be made to insure that the quantity and power of explosives used shall neither open seams, nor crack, nor damage the rock outside the prescribed limits of excavation. Whenever, in the opinion of the Owner, further blasting might injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation completed by wedging and barring or other suitable methods.
The length of holes, the firing pattern and the charges shall be designed by a professional engineer working for and paid by the Contractor and a record shall be kept of all patterns and charges used in each excavation. One copy of the record shall be submitted to the Owner on a weekly basis.

Where shown on the Drawings and/or where directed by the Owner, slopes shall be lined, drilled or pre-split by a method approved by the Owner. The spacing of the line holes shall be sufficiently close to ensure that the rock breaks along the design lines.

D. Disposal of Materials.....So far as practicable, as determined by the Owner, all suitable materials from excavation in rock for the outlet works shall be used in the permanent construction required under these Specifications.

The Contractor's blasting and other operations and excavations shall be such that the excavation shall yield as much suitable material for construction as practicable, and shall be subject to the approval of the Owner. Where practicable, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The suitable materials shall be placed in the designated final locations directly from the excavation, or shall be placed in temporary stockpiles and later placed in the designated locations as directed by the Owner.

E. Temporary Support of Slopes.....When in the opinion of the Owner, temporary support of excavation slopes is required in the vicinity of the excavation for the intake and outlet structures of the outlet works, that temporary support methods shall be provided in accordance with Section 21 of these Specifications.

F. Tolerances and Clean Up.....Where concrete is to be placed directly upon or against the excavation, such excavation shall be sufficient at all points to provide for the minimum dimensions of concrete. Where dimensions of the concrete structure are shown on the Drawings or the elevation of the foundation is indicated, such dimensions shall be considered as the minimum dimensions and such elevations shall be considered as the elevation determining the minimum dimensions of the structure. Where a dimension or an elevation is not indicated on the Drawings, minimum dimensions shall be established by the Owner. The excavation shall be cleaned with water, air, or other suitable means of all loose material and inspected prior to the placement of concrete.

The Contractor shall trim the surfaces of the rock excavation such that rock does not interfere with the dimension of the structure. The tolerance for the rock excavation shall be minus 1 foot.

G. Inspection.....Foundation surfaces shall not be covered by any material until they are inspected and approved in writing by the Owner. The foundation shall be cleaned off with water, air, or other suitable means to allow the required inspections. The Contractor shall give to the Owner at least 48 hours notice of the readiness of the outlet works foundations for final inspection.
3.4 EXCAVATION, ROCK-SPILLWAY

A. General....Excavation in rock for the spillway includes all required rock excavations to the lines, grades, and dimensions shown on the Drawings or as directed by the Owner for the spillway crest structure, spillway, cascades, and the road from the spillway to the dam.

B. Classification of Rock Excavation....For purposes of payment, the term "rock excavation" is defined as excavating the material defined as rock in Part 1.4A of this Section of the Specifications and includes all solid rock in-place which cannot be removed until loosened by blasting, barring, or wedging and all boulders or detached pieces of solid rock more than 1 cubic yard in volume.

C. Crest Structure.....The excavation for the crest structure shall be made to sufficient depth, as determined by the Owner, or as shown on the Drawings to secure foundations on fresh to slightly weathered rock essentially free from weathered materials, open seams, underlying seams, or other objectionable defects that may exist in the foundation. At the option of the Contractor and with the approval of the Owner, line drilling and light blasting, or other similar methods may be employed. If line drilling and light blasting are employed, the diameter, spacing, and depth of the hole shall be subject to the approval of the Owner, and the spacing shall be such as to insure that the material shall break along the desired lines. The light blasting shall be limited to approved methods which provide for successive fracturing of the worked face as the work is advanced by the use of power tools and hand work. Whenever, in the opinion of the Owner, further blasting might injure the surfaces upon or against which concrete is to be placed, the use of explosives shall be discontinued.

D. Cascades and Plunge Pools.....The excavation for the cascades and plunge pools is intended to provide the required quantity of material for Zones 2 and 3 of the dam embankment. Those materials shall be quarried from required excavation in the cascades and plunge pools except where the Owner approves the use of suitable material from other sources.

The Contractor shall conduct all his quarrying operations in the cascades and plunge pools in accordance with the Borrow Management Plan approved by the Owner at least 45 days prior to the start of the quarrying operations or with such modifications as may be approved by the Owner from time to time.

Any proposals for such modifications submitted by the Contractor shall describe the proposed method of working in the excavation, including the sequence of operations, any substantial variations, not in conflict with the requirements of this Section of the Specifications, and the configuration of the benches and the floor of the cascades or in the lines, grades and dimensions of the permanently exposed slopes which comprise the sides of the spillway and cascades.

The Contractor may at his option, vary the lines, grades and dimensions to suit his method of construction, provided that:

1. The Contractor proposals are in accordance with the detailed
requirements of this part of the Specifications.

2. Vertical distances between adjacent benches and between adjacent berms do not exceed 70 feet.

3. The elevation of the downstream edge of each bench remains as shown on the Drawings.

4. Slopes between benches are as shown on the Drawings or as directed by the Owner, and slopes adjacent to the natural surfaces are flattened as directed by the Owner.

5. The benches for any particular excavation are substantially parallel and provision is made for longitudinal falls and cross-falls for drainage equivalent to that shown on the Drawings; and the bench widths are such that there is a minimum clear passage of not less than 20 feet.

As shown on the Drawings, the downstream lips of the risers shall be reinforced with pre-support rock dowels installed in accordance with the requirements in Section 21 of these Specifications.

E. Tolerances and Clean Up....On completion of the excavation of any bench, the Contractor shall trim the surfaces of the bench and adjoining slopes to the final lines and grades, to within the following tolerances of rock:

1. Benches-plus or minus 1 foot.

2. Slopes-plus or minus 3 feet.

3. Foundations for concrete structures-plus zero and minus 1 foot.

4. On completion of the excavation for the spillway and cascades, but before the completion date for the project, the Contractor shall remove from all benches all loose rock, boulders and debris to the satisfaction of the Owner. Material with which depressions in the rock have been filled for the passage of haul traffic shall be removed to the extent practicable, in the opinion of the Owner, using mechanically tracked equipment provided that adjacent rock projections are exposed and that all loose material within 10 feet of edges of benches shall be removed by hand methods.

F. Blasting.....Every effort shall be made to ensure that the quantity and power of explosives used shall neither open seams, nor crack, nor damage the rock outside the prescribed limits of excavation. Whenever, in the opinion of the Owner, further blasting might injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation completed by wedging and barring or other suitable methods.

The length of holes, firing pattern and the charges shall be designed by a professional engineer working for and paid by the Contractor and a record shall be kept of all patterns and charges used in each excavation. One copy of the record shall be submitted to the Owner on a weekly basis.
Where shown on the Drawings and/or where directed by the Owner, slopes shall be line drilled or pre-split by a method approved by the Owner. The spacing of the line holes shall be sufficiently close to ensure that the rock breaks along the design lines.

G. Disposal of Materials...So far as practicable, as determined by the Owner, all suitable materials from excavation in rock for spillway shall be used in the permanent construction required under these Specifications.

The Contractor's blasting and other operations in excavation shall be such that the excavation shall yield as much suitable material for construction as practicable, and shall be subject to the approval of the Owner. Where practicable, as determined by the Owner, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The suitable materials shall be placed in the designated final locations directly from the excavation, or shall be placed in temporary stockpiles and later placed in the designated locations as directed by the Owner.

3.5 EXCAVATION, ROCK-TRENCHES, PITS, AND FOOTINGS

A. General...Excavation in rock for trenches, pits and footings includes all rock excavations to the lines, grades, and dimensions shown on the Drawings or as directed by the Owner for trenches, pits and footings for small miscellaneous structures.

B. Classification of Rock Excavation...For purposes of payment, the term "rock excavation" is defined as excavating the material defined as rock in Part 1.4A of this Section of the Specifications and includes all solid rock in-place which cannot be removed until loosened by blasting, barring, or wedging and all boulders or detached pieces of solid rock more than 1 cubic yard in volume.

C. Method of Excavation...Excavation for trenches, pits and footings shall be performed by the use of hand tools and approved mechanical equipment, in such a manner as to prevent shattering of the sides and bottom of the excavation. At the option of the Contractor, and with the approval of the Owner, line drilled holes and light blasting holes may be employed in locations approved by the Owner.

D. Blasting...Every effort shall be made to ensure that the quantity and power of explosives used shall neither open seams, nor crack, nor damage the rock outside the prescribed limits of excavation. Whenever, in the opinion of the Owner, further blasting might injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation completed by wedging and barring or other suitable methods.

The length of holes, firing pattern and the charges shall be designed by a professional engineer working for and paid by the Contractor and a record shall be kept of all patterns and charges used in each excavation. One copy of the record shall be submitted to the Owner on a weekly basis.
Where shown on the Drawings and/or where directed by the Owner, slopes shall be line drilled or pre-split by a method approved by the Owner. The spacing of the line holes shall be sufficiently close to ensure that the rock breaks along the design lines.

E. Disposal of Materials.....So far as practicable, as determined by the Owner, all suitable materials from excavation in rock for trenches, pits and footings shall be used in the permanent construction required under these Specifications.

The Contractor's blasting and other operations in excavation shall be such that the excavation shall yield as much suitable material for construction as practicable, and shall be subject to the approval of the Owner. Where practicable, as determined by the Engineer, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The suitable materials shall be placed in the designated final locations directly from the excavation, or shall be placed in temporary stockpiles and later placed in the designated locations as directed by the Owner.

F. Inspection.....Foundation surfaces shall not be covered by any material until they are inspected and approved in writing by the Owner. Footing foundation shall be cleaned off with water, air, and other suitable means to allow the required inspections and prior to concrete placements. The Contractor shall give the Owner at least 24 hours notice of the readiness of excavations for final inspection.

3.6 EXCAVATION, ROCK-QUARRY AREAS

A. General.....Excavation in rock for the quarry areas includes all rock excavations in quarry areas that are required to supplement the volume of rock obtained from the spillway excavation for the permanent works covered by these Specifications. The Contractor shall operate the required quarries to obtain material additional to that obtained from the required excavation, for rockfill for the dam embankment, concrete aggregate, and other uses for the permanent construction.

B. Classification of Rock Excavation.....For purposes of payment, the term "rock excavation" is defined as excavating the material defined as rock in Part 1.4A of this Section of the Specifications and includes all solid rock in-place which cannot be removed until loosened by blasting, barring, or wedging and all boulders or detached pieces of solid rock more than 1 cubic yard in volume.

C. Operation of Quarry.....Not less than 30 days prior to commencement of rock excavation operations, the Contractor shall submit, to the Owner for approval, details of his proposed method of working the quarry, including the sequence of operations, height of faces, locations of benches and preventing erosion hazards. The quarry operation shall be coordinated with the Borrow Management Plan. No quarry operations shall take place until the Owner agrees with the proposed method of operation and agrees that the need for rock from a quarry is required for the permanent works.
Nothing in this Section shall relieve the Contractor from the responsibility for the adequacy and safety of the rock excavation operations.

As far as practical, as determined by the Owner, the Contractor shall locate and work the quarry to ensure that the maximum amount of sound rock is obtained. Prior to commencing excavation for rock from the quarry, the Contractor shall clear and strip the area of the proposed quarry in accordance with the provisions of Part 3.1 of this Section of the Specifications. The Contractor shall strip from the surface of the area all material which is unsuitable for use in the construction of the permanent works. Materials stripped from the quarry shall be disposed of in approved disposal areas in accordance with the requirements of Section 2G of these Specifications.

End of Section
SECTION 2D - PRESSURE GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

The work covered by this Section of the Specifications includes supplying all labor, plant, power, equipment, water, caulking leaks, and materials; and performing all operations in connection with drilling, washing, water testing and pressure grouting grout holes; patching the finished grout holes; care and disposal of drill cuttings, wastewater and waste grout; clean up of the areas upon completion of the work; and all other such operations as are incidental to the drilling and pressure grouting for Deer Creek Dam and appurtenant facilities.

1.2 EXTENT OF WORK

A. The work is –

1. Drilling and pressure grouting through the plinth of the dam (using cast-in-place standpipes or through holes drilled in the concrete by the Contractor) for consolidation grouting as shown on the Drawings or as directed by the Owner.

2. Drilling and pressure grouting through the plinth of the dam (using cast-in-place standpipes or holes drilled through the concrete by the Contractor); and through the concrete spillway slab (using cast-in-place standpipes, or holes drilled through the concrete by the Contractor) and through the rock adjacent to the spillway structure for curtain grouting as shown on the Drawings or as directed by the Owner.

3. Drilling and pressure grouting from within the outlet works tunnel before the permanent concrete and steel linings have been placed for curtain grouting as shown on the Drawings or as directed by the Owner.

4. Drilling and pressure crown grouting through the concrete lining and steel lining (using pre-drilled holes in the steel lining) all spaces in the roof and side walls of the outlet works tunnel remaining unfilled after placing the concrete and steel linings as shown on the Drawings or as directed by the Owner.

5. Drilling through the steel lining and interface pressure grouting behind the steel lining in the outlet works tunnel and shaft as shown on the Drawings and as directed by the Owner.

6. Pressure crown grouting for the tunnel plugs as shown on the Drawings and directed by the Owner.

7. Drilling and pressure grouting miscellaneous holes for faults, joints, shear zones, springs and other rock defects that may require pressure grouting as determined by the Owner in the dam foundation excavation, spillway excavation and outlet works tunnel and shaft excavation. Miscellaneous grouting shall also include drilling and grouting feeler and pilot holes in the tunnel and shaft excavations where directed by the Owner.
The drilling and pressure grouting requirements shown on the Drawings and described herein are tentative. The amount and locations of drilling and grouting that shall actually be required shall be governed by conditions revealed as work progresses. The Contractor is advised that the extent of work shall be determined by the Owner to suit site conditions. The number, spacings, positions and depth of grout holes are uncertain and shall depend on the nature of the rock disclosed by the excavations, the results of water testing and the results of actual grouting operations. Drilling; grouting procedures including grout mixes, pressures, pumping rates, and the sequence in which holes are drilled and grouted shall be determined in the field and shall be as directed by the Owner.

1.3 COORDINATION WITH OTHER CONTRACTORS

It is to be noted that the areas where grouting is to be carried out will also be subject to other construction activities while pressure grouting operations are in progress. Coordination by the Contractor with other construction activities shall be done during the grouting operations.

1.4 ORDER OF WORK

The Contractor shall be responsible for scheduling and determining the order of grouting operations which are compatible with the Contractor’s general construction schedule and which meets the requirements for pressure grouting given in this Section of the Specifications. It may be necessary to temporarily suspend grouting operations because of conflicts with other construction activities, because concrete work and steel linings through which the pressure grouting is to be done have not been completed, or because excavation required before pressure grouting can be done has not been completed. In such an event, no standby time or other additional payment shall be made over the rates bid for the various items of work.

As drilling and grouting work progresses, all or parts of areas already grouted may require additional grouting. In such event, the equipment shall be returned and additional holes for grouting shall be drilled and grouted as directed by the Owner, and no additional payment shall be made over the rates bid for the various items of work.

1.5 CONTRACTOR’S GROUTING SCHEDULE

The Contractor shall submit a detailed grouting schedule to the Owner at least 30 days prior to the start of grouting at a specific work area. The Contractor shall receive no payment for pressure grouting work at a specific work area until the Owner approves the Contractor’s detailed grouting schedule for the specific work area.

The Contractor’s grouting schedule for a specific work area shall describe the specific work area to be pressure grouted and indicate the anticipated drilling and grouting sequence. The schedule shall also include the anticipated time required for completion of the grouting work for the specific work area.
The schedule shall include the number and types of equipment that shall be used for the specific work area. Equipment described in the schedule shall include drills, grout mixers, agitators tanks, bentonite hydration tanks, grout pumps, grout supply lines, packer and all standby equipment available for immediate replacement of inoperative equipment.

The method of stabilizing the drilling equipment and the method of providing access to the grout holes shall be included in the grouting schedule for specific work areas.

1.6 EXTRA COMPENSATION

Except as provided in these Specifications, the Contractor shall not be entitled to any extra compensation above the unit rates bid, by reason of increased or decreased quantities, or no drilling or grouting, or by reason of the location of the required drilling and grouting, or by reason of unanticipated increases in the quantity of clean up, dewatering, caulking, by having to deepen holes, or temporary suspension of the grouting operations.

No additional allowance above the unit rates bid shall be made on account of any amount of moving of equipment that may be necessary due to drilling and grouting requirements.

1.7 INSPECTIONS

All drilling, washing, water testing, and grouting operations shall be performed in the presence of an authorized representative of the Owner. The Owner shall keep records of all drilling, water testing, and grouting. Each sheet of the drilling and grouting record shall be signed by the Contractor to verify that the information shown thereon is correct.

1.8 SAMPLES OF GROUTING MATERIALS

At least 30 days prior to the start of pressure grouting, the Contractor shall supply the Owner with two sacks of cement and one sack of bentonite from the stockpile of cement and bentonite which shall be used for pressure grouting. An additional two sacks of cement and one sack of bentonite shall be supplied to the Owner for every 5,000 sacks of cement used in pressure grouting. All costs associated with providing cement and bentonite samples shall be included in the unit bid price for Pressure Grouting in the Bid Schedule.

PART 2 - PRODUCTS

2.1 CEMENT

The cement shall be type II Portland cement as specified in Division 3 of these Specifications. Only fresh cement, free from lumps shall be used.
2.2 BENTONITE

The bentonite shall be a suitable commercially processed powdered sodium bentonite free of additives and approved by the Owner.

2.3 WATER

Water used in pressure grout shall be clean and free from harmful amounts of oil, acid, alkali, organic or vegetable matter. Water having a temperature above 80°F shall not be used in grouting operations.

2.4 STANDPIPES AND FITTINGS

All pipes and fittings required for installation of the standpipes shall be Weight-A, Class 1, standard black pipe in accordance with Federal Specification WW-P-406c. The pipe fittings shall be malleable iron or steel, Type I, in accordance with Federal Specification WW-P-521F or as approved by the Owner. The size of the pipe is shown on the Drawings.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. General... All drilling, washing, water testing and grouting equipment used shall be of a type, capacity and mechanical condition suitable for doing the work.

All equipment shall be subject to examination by the Owner in relation to its suitability and continued functional efficiency. The Contractor shall submit details of proposed equipment in the Contractor's grouting schedule as described in Part 1.5 of this Section of the Specifications, to enable adequate consideration of the equipment offered.

Operators employed shall be experienced in the use of the drilling and grouting equipment, shall be competent and shall be able to carry out all the work required without additional assistance.

Effective communication shall be provided between the grout plant and the point of grout injection.

B. Grouting Plant... The Contractor shall supply the separate combinations of grout mixer, holdover mechanical agitator tank, bentonite hydration tank, grout pump, operators and associated equipment needed to accomplish the work given in Part 1.1 of this Section and the grouting procedures given in Part 3.5, 3.6, 3.7, and 3.8. Sufficient standby equipment shall be available to ensure that no interruptions to continued grouting at each specific work area occur. Any grout hole lost due to inoperable equipment shall be replaced at the Contractor's expense. The apparatus for mixing and placing grout shall be of a type and size that is capable of mixing and stirring effectively the grout and of forcing it into the grout holes or grout connections in a continuous, uninterrupted flow.

1. Grout Mixers... Grout Mixers shall be provided by the Contractor. The
mixers shall be operated mechanically and provided with accurate meters, reading in cubic feet to tenths of a cubic foot, for controlling the amount of mixing water used in the grout. The mixers shall have a minimum volume of 17 cubic feet. All grout shall be mixed in high speed mixers operating at a minimum mixing speed of 1,500 revolutions per minute. Mixers shall be of sufficient capacity to produce grout at the rates required by the hole or holes being grouted.

2. Bentonite Hydration Tanks.....Bentonite hydration tanks shall be provided by the Contractor. The hydration tanks shall have either a mechanical paddle or air bubbling system to gently and continuously agitate the water-bentonite slurry. The bentonite hydration tanks shall be provided with a mechanism to transfer the water-bentonite slurry through meters into the high speed mixers. The meters shall be accurate, reading in cubic feet to tenths of a cubic foot, for controlling the amount of hydrated bentonite slurry in the grout. The bentonite hydration tanks shall be of sufficient capacity to provide hydrated bentonite slurry to the grout mixers at the rates required by the hole or holes being grouted without interruption.

3. Agitator Tanks.....Holdover mechanical agitator tanks shall be provided by the Contractor. Agitators shall be fitted with baffles to reduce vortex formation and shall be provided with accurately marked dip sticks to enable measurement of their contents. The hold agitator tanks shall have a similar volume as the grout mixers.

4. Grout Pumps.....Grout pumps shall be provided by the Contractor. Grout pumps shall be efficient and capable of running continuously for at least 12 hours under normal load. They shall be capable of delivering all necessary quantities up to 60 gpm at a pressure of 250 psi and be capable of pumping grout having a water to cement ratio of one-half to one (W:C ratio=0.5:1 by volume). Grout pumps shall be of the "Mono" type or similar, comprising a helical rotor rotating in a stator of double internal helix form.

C. Grout Supply Lines.....The grout supply lines, valves, connections and associated equipment shall be furnished by the Contractor. The arrangement of the grouting equipment shall be such as to provide a supply line and return line from the grout pump to the grout hole. Provisions shall be made to permit continuous circulation and accurate control of grouting pressures and grout flows into the grout holes and connections. Valves in contact with grout shall be of diaphragm type and lubricated plug cock type. The minimum size of the supply line and manifold including valves and fittings shall be 1-1/2-inch inside diameter.

D. Packers.....Packers, grouting tubes, air supply lines (for inflatable packers), fittings and associated equipment for grouting within the drill holes shall be furnished by the Contractor. The Contractor shall have available at all times a sufficient number and variety of packers to accomplish the grouting. Packers are devices which seal off the drill holes at any elevation to permit water testing and grouting of a selected section of drill hole below the packer or between two packers. Packers shall consist of mechanically expandable tubes, inflatable packers, or rings of rubber, leather or other suitable materials. When
expanded, packers shall be capable of withstanding, without leakage, water pressure equal to the maximum grout pressure to be used. The supply pipes to the packers and pipes through the packers shall have a minimum inside diameter of 1 inch. Inflatable packers shall have a minimum length of 3 feet. Double inflatable packers, pipes and associated equipment necessary for varying the packer spacings between 10 feet and 1 foot shall be provided by the Contractor.

E. Pressure Gauges.....Pressure gauges and associated equipment for measuring grout pressures shall be furnished by the Contractor. For each hookup being water tested or grouted, two accurate pressure gauges shall be installed for pressure measurements, one gauge at the grout pump and one gauge in the manifold at the collar of the hole.

Pressure gauges shall be of a type approved by the Owner and shall be checked against calibrated gauges at maximum intervals of seven days. Results of gauge calibration tests shall be immediately given to the Owner. Calibrated gauges shall be supplied, maintained and regularly tested by the Contractor. The testing of calibrated gauges shall be certified by a registered laboratory.

Each gauge shall be fitted with an approved device to prevent entry of grout to the gauge mechanism. Each gauge shall be identified by a number. Gauges shall be in pressure units of psi and shall be of suitable range for the pressures to be measured.

F. Flow Meters.....Flow meters and associated equipment for measuring water added to the grout, bentonite slurry added to the grout, and for water tests, shall be furnished by the Contractor.

Flow meters shall be of a type approved by the Owner and shall be checked against a calibrated flow meter at maximum intervals of seven days. Results of flow meter calibration tests shall be immediately given to the Owner. The calibrated flow meter shall be supplied, maintained and regularly tested by the Contractor. The testing of the calibrated flow meter shall be certified by a registered laboratory.

Each flow meter shall be identified by a number. Flow meters for measuring water and bentonite in the grout shall be in units of cubic feet.

Flow meters used for water tests shall be in units of gallons and be accurate to a tenth of a gallon.

G. Drills.....The Contractor shall furnish the number, types of drills, and associated equipment needed to accomplish the drilling operations described in Part 1.1 of this Section and the drilling procedures given in Parts 3.4, 3.5, 3.6, 3.7, and 3.8 of this Section.

3.2 STANDPIPES AND FITTINGS FOR GROUT CONNECTIONS

A. General.....Standard pipe standpipes and fittings as specified in Part 2.4 of this Section for consolidation, curtain, and miscellaneous grouting connections shall be set in rock or concrete at locations shown on the Drawings and specified below. When directed by the Owner, the
Contractor shall supply and install additional standpipes in concrete or rock, as shown on the Drawings and specified below. The locations, directions and inclinations of the additional standpipes shall be as directed by the Owner.

Any damage caused to standpipes by the Contractor or by his labor, plant or equipment shall be repaired at no cost to the Owner.

B. Installation.....The grout standpipes and fittings shall be installed in rock or concrete as shown on the Drawings. All pipes, fitting, cement, and temporary supports required for installation of the standpipes shall be furnished by the Contractor.

Steel reinforcement and anchor bars may be encountered when drilling through the concrete plinth and spillway slab. If this occurs, a new location for the standpipe shall be directed by the Owner. Payment for drilling the abandoned hole and backfilled the hole with 1:1 water-cement grout shall be made at the unit price bid for standpipes and fitting on the Bid Schedule.

Before being installed in concrete or rock, all pipes and fittings for consolidation, curtain, and miscellaneous grouting shall be cleaned thoroughly of all dirt, grease, grout and mortar. The embedded ends shall be covered with a plastic membrane or plugged with a relatively weak material which can be easily drilled or washed out. The pipe and fittings shall be carefully assembled, accurately placed and securely held in position and protected from damage during grouting or casting-in-place. The Contractor shall ensure that all parts of the system are maintained free from dirt and foreign substances.

The bottom end of each stand pipe installed in concrete or rock shall be flared or have a coupling for anchoring securely, to withstand grout pressures of up to 250 psi.

Standpipes used to steady drilling equipment which are damaged during drilling shall be replaced at no cost to the Owner.

C. Removal of Standpipes and Fittings.....On completion of grouting through concrete or rock, the wrapped, screwed extension piece shall be removed, and the remaining hole shall be backfilled completely with 1:1 water-cement grout.

3.3 HOOD-UPS TO GROUT HOLES AND CONNECTIONS

"Hook-up" shall be defined for the purposes of this Agreement, as the connection to the hole or other grout connections all fittings, hoses, valves, pipes, gauges, meters, pumps, packers, mixers, agitators, bentonite hydration tanks and any other items of equipment necessary to enable the injection of grout into the hole to be commenced. The Contractor shall supply all necessary labor, tools, and equipment for the hook-up operation.
3.4 DRILLING GROUT HOLES
------------------------
A. Drilling Requirements.....All holes are to be drilled at the locations, depths and at the inclination shown on the Drawings or as directed by the Owner. Where information necessary for setting out the holes is not shown on the Drawings, the Owner shall provide the Contractor with the information.

The Contractor shall drill the grout holes by either or both of the following methods:

1. Wet percussion-type drilling;
2. Diamond rotors-type drilling.

The Contractor shall be responsible for deciding which of the drilling methods shall be used to drill a grout hole except that percussion-type drilling shall not be done when drilling through the concrete tunnel lining. Interface grouting shall require drilling and sealing holes in the steel tunnel and shaft lining. Crown grouting may require drilling holes through steel tunnel supports.

The use of "Rod Dope", grease, or other lubricant on the drill rods in the drill holes shall not be permitted.

The minimum diameter of wet percussion drilled holes shall be 1.5 inches and the minimum diameter of diamond drilled holes shall be not less than that produced by a commercial EX size bit (approximately 1.5 inches). The maximum diameter of grout holes using either drilling method shall be 4 inches. Drilling equipment and techniques shall be such as to minimize causing the hole to cave or become oversized.

During drilling, an adequate flow of water shall be used to wash cuttings to the surface.

Grout holes shall be drilled in a closure sequence as shown on the Drawings or as directed by the Owner. Holes shall be identified by a numbering system as directed by the Owner.

Maximum depth of consolidation grout holes is expected to be 40 feet. Maximum depth of miscellaneous grout holes is expected to be 40 feet. Maximum depth of curtain grout holes is expected to be 250 feet. However, the Contractor shall drill curtain grout, or consolidation grout holes, or miscellaneous grout holes to greater depths when directed by the Owner.

Location of holes measured at any point along the length of the hole shall have a maximum allowable horizontal deviation from the designed location, or location as otherwise directed by the Owner, of 1/15th of the length of the hole from the top of the standpipe to the point considered. Any hole incorrectly located by the Contractor is to be pressure grouted full with 1:1 cement grout. All costs of drilling and pressure grouting incorrect holes including the cost of cement and any other materials shall be borne by the Contractor.
No payment shall be made for a hole abandoned due to loss of drilling or grouting equipment down the hole or for a hole abandoned due to the Contractor's inability to provide the required depth of hole. The abandoned hole shall be pressure grouted full with 1:1 water-cement grout. All costs of drilling and pressure grouting the abandoned hole including the cost of cement and any other materials shall be borne by the Contractor.

Sufficient drilling equipment, operators and ancillary equipment shall be provided to ensure that the grouting operation is not delayed.

No drilling, or water testing, or pressure washing shall be performed at points within 100 feet of holes then being grouted under pressure or that were grouted within the previous 24 hours.

No drilling shall be done in concrete until the concrete has attained 80 percent of its design strength as determined by the Owner.

Upon completion of drilling of any stage of a hole, it shall be temporarily capped using a threaded metal screw cap or other suitable temporary plug to protect it from entry of foreign matter until grouting or further drilling operations require it to be reopened.

If, in the Owner's opinion, a hole has been blocked as a result of the Contractor's negligence after the time of drilling, the Contractor shall return and redrill the hole at no cost to the Owner.

Whenever the drill water is lost, or artesian flow is encountered, or severe cave-in of the hole occurs while drilling, the drilling operations shall be stopped and the affected section shall be water tested, washed and grouted before drilling operations are resumed.

Approval of the Owner shall be required before moving drilling equipment over the concrete plinth, spillway slab and tunnel and shaft lining. Sections of the plinth and abutments are very steep and the Contractor is to provide means of gaining access to drill hole locations and maintaining equipment steady while drilling. Methods of gaining access and steadying equipment and moving drilling equipment up and down the steep site slopes shall be submitted for approval by the Owner. Grout pipe connections secured by threads in the steel lining shall not be used to steady drilling equipment in the tunnel and shaft.

B. Materials to be Drilled Through.....Most of the drilling for pressure grouting will be through rock, some will be through concrete, some through the outlet works steel liner, some through grout, and some through steel tunnel supports. No differentiation shall be made between materials as far as payment is concerned.

The rock at the Deer Creek dam site which will be drilled for pressure grouting consists of complexly intermixed granite, granite (felsic) gneiss, and mafic and felsic intrusive rock which are usually hard, dense and strong. Fault breccias, shear zones and areas of altered rock are also present and will also be drilled through. The fault breccias and shear zones have the consistency of soil and contain clay materials. The altered rock varies from hard, dense and strong to soft and weak.
The rock is complexly fractured and jointed. Logs of the geotechnical exploratory holes are in Appendix A of these Specifications. Drilling water circulation was lost in several of the geotechnical exploratory holes as shown on Table A-III in Appendix A.

Class B concrete at greater than 80% design strength shall be encountered in locations including the plinth, spillway structure, and tunnel and shaft linings. The concrete shall contain steel reinforcing bars, steel rock bolts, steel diversion pipes, steel anchor bars and steel tunnel and shaft supports.

Anchor bars, rock bolts, and reinforcing steel may be encountered when drilling through the plinth and spillway slab. Reinforcing steel, steel tunnel and shaft supports and diversion pipes may be encountered when drilling through the tunnel and shaft. If this situation arises and the Owner is satisfied that the hole has to be abandoned, the partly drilled grout hole shall be pressure grouted with a 1:1 water-cement grout and a new hole shall be relocated by the Owner. Drilling and grouting the partly drilled hole and drilling the new hole, including standpipe, shall be paid by the Owner under the appropriate items and rates in the Bid Schedule.

3.5 WASHING, TESTING AND GROUTING

A. Washing. Washing of holes shall be required immediately after drilling to ensure a clean hole for water testing and grouting. Washing of holes shall also be required after grouting to prepare the hole for another grout application when the down stage grouting procedure is used.

The walls of the holes shall be thoroughly washed with radial jets of air and clean water under pressure, using a wash-out bit. Washing shall be carried out separately to the drilling operation.

Washing shall be carried out using air and water and shall include pressure washing as described in Parts 3.6B, 3.7B, and 3.8B of this Section.

Suitable labor and equipment to carry out the washing procedure shall be supplied by the Contractor and shall include supply of water by the use of pumps and/or water tanks to maintain the water pressure. Equipment shall include steel washout bits attached to a water pipe to be used to clean a hole of grout prior to further grouting of the hole. The washout bits shall provide a radial jet of air and water under pressure.

Grouted holes requiring deeper stage drilling shall be washed out between 2 and 5 hours after completion of grouting.

If the Contractor fails to wash out a grouted hole, or fails to wash out a grout hole completely, the Contractor shall clean the hole by drilling at no cost to the Owner.

B. Water Testing. Some grout hole stages (prior to grouting) shall be pressure water tested. Water testing shall be carried out in accordance with Parts 3.6B, 3.7B, 3.7C, and 3.8C of this Section.
The Contractor shall supply suitable labor and equipment for pressure water testing holes and this shall include pumps, delivery lines, storage tanks, gauges, meters, packers, and all associated equipment. Water shall also be supplied by the Contractor.

All water testing operations shall be performed in the presence of an authorized representative of the Owner.

C. Grouting.....All grout shall be mixed in high speed mixers operating at a minimum mixing speed of 1,500 revolutions per minute. Bentonite, when used, shall be hydrated in a hydration tank at least 2 hours before the bentonite is added to the grout in the high speed mixers. Mixing time shall be adequate to obtain grout which, in the opinion of the Owner, is effectively mixed. Mixers shall be of sufficient capacity to produce grout at the rates required by the hole or holes being grouted, and without interruption due to mixer breakdown.

After mixing, cement grout or bentonite-cement grout shall be discharged from the mixers, to agitators, and then pumps shall draw grout from the agitators, through a screen, and pump grout around a circulation line past the grout holes (or pipes) and then back to the agitator. Grout fittings on the holes (or pipes) shall be directly connected to the circulation line, without intervening hoses. All grout used shall be drawn from the circulation line.

The Contractor shall be responsible for supplying sufficient cement, bentonite, water, caulking, and other materials and equipment to the work areas to ensure continuity of work.

Grout pumps shall be located suitably to obtain pressures at the holes (or pipes) which are not excessively greater than those required for grouting.

Control of the grout injection and pressures shall be exercised by means of fittings at the points of injection into grout holes (or pipes). These fittings shall be mounted directly on the standpipes of holes, or on the grouting tubes of packers, or on grout pipes, etc., without the use of intervening hoses. The fittings shall include a valve to control the quantity of grout entering the grout holes (or pipe), and to control its pressure. A pressure gauge shall be mounted between this valve and the hole (or pipe), together with a valve, discharging to waste, through which thin grout, water, and/or air shall be bled off periodically. A pressure relief valve shall be mounted at the top of each hole. A valve may be mounted on the circulation line, beyond each offtake to a hole (or pipe). The Contractor shall attach such other fittings as the Owner may direct, including fittings for attachments of metering equipment supplied and operated by the Owner.

A full record of grouting shall be kept by the Owner. Each sheet of the record shall be signed by the Contractor to verify that the information shown thereon is correct. This information shall include:

1. Identification of the hole and stage;
2. date and times for the grouting operation;
3. water-cement ratios;

4. the number of sacks of cement and the cubic feet of bentonite added to the grout mix during each 15 minute period;

5. quantities of grout in the agitator at the beginning and end of consecutive 15 minute periods during the grouting operation;

6. calculation of the quantity of cement injected in consecutive 15 minute periods;

7. grout pressures;

8. details of all connections and leaks, including estimated grout losses and remedial measures taken;

9. the results of the previous water test on the stage concerned, and;

10. An estimate of line wastage on the stage grouted.

Grout in the circulation lines and agitators shall be discarded or replaced if it has not been used 4 hours after mixing. The unused bentonite slurry shall be discarded every 24 hours.

Grouting shall not be commenced in an area until all blasting has been completed within 300 feet.

The Contractor shall have sufficient caulking available at the work site should grout leaks or interconnection to other holes develop. The Contractor shall caulk leaks or take suitable preventative measures as directed by the Owner.

3.6 PLINTH AND SPILLWAY GROUTING OPERATIONS

A. General....In order to give the Contractor an appreciation of the proposed method of work, number of operators and ancillary equipment and materials to be supplied, etc., the proposed grouting operation at the plinth and spillway is described in this Section. Drilling shall be done in accordance with Part 3.4 of this Section. Washing, water testing and grouting shall be in accordance with Part 3.5 of this Section.

Pressure grouting at the plinth and spillway shall be done to construct: (1) double row consolidation grouting below the concrete plinth after the plinth has been constructed, the downstream consolidation row shall be extended to construct the grout curtain below the plinth, (2) a single row grout curtain below the concrete plinth after the plinth has been constructed, and (3) a single row grout curtain in the spillway area after the concrete spillway structures have been constructed. Pressure grouting in the spillway area shall be done below the completed concrete structures and in the rock adjacent to the spillway structures.

Definitions -

1. Zone.....A zone is a predetermined partial depth of grouting as shown on
the Drawings. The anticipated depths of the zones, and the spacing of grout holes are shown on the Drawings. However, these depths and spacings may be varied in accordance with conditions encountered during drilling and grouting operations and as directed by the Owner.

2. Section.....A section is a reach along the plinth and spillway, in which grouting operations shall not be permitted at the same time that drilling, washing and water testing are in progress. Insofar as practicable, the plinth and spillway curtain shall be subdivided into sections in a manner which will facilitate the Contractor's operations.

3. Split Spacing Method.....Split spacing method is the procedure of locating an additional grout hole midway between two previously drilled and grouted holes.

4. Packer Grouting.....Packer grouting consists of drilling a hole to full required depth in one operation, or extending a hole from the bottom of a pre-determined depth and grouting at different stages within the zones by means of a packer from the bottom upward.

5. Stage.....A stage is a partial or complete depth of hole to be grouted within any given zone. The actual depth of a stage depends upon geologic conditions encountered during drilling.

6. Down Stage Grouting.....Down stage grouting consists of drilling a hole to a limited depth, grouting to that depth, cleaning the hole before the grout has set sufficiently to require redrilling, letting the grout surrounding the hole set, drilling the hole to another limited depth, grouting to the new depth increment, and thus continuing in as many stages of drilling and grouting as may be necessary.

B. Washing and Water Pressure Testing.....Before the pressure grouting of each stage of any hole is begun, the hole shall be thoroughly washed using air and water. Pressure washing is to clean all intersected rock seams and crevices containing clay or other washable materials. If practicable, as determined by the Owner, clay and other washable materials shall be ejected from one or more holes by introducing water and air under pressure into an adjacent hole. In no case shall such pressure exceed the maximum grouting pressure as directed by the Owner.

After washing each hole, or stage of a hole, the Owner shall determine if water testing is required prior to grouting. If required, the hole or stage of a hole shall be water tested by pumping clean water under continuous pressure for 10 minutes after flow stabilization, or for a longer period as directed by the Owner. The test pressure measured at the top of the hole for the first 5 minutes shall be 10 psi. The test pressure for the second 5 minutes shall be the relevant grouting pressure. Adjacent holes which have not been grouted shall be uncapped during the water test. Any surface leaks or connections with other holes shall not be caulked until after completion of the test unless otherwise directed by the Owner.

When a packer is to be used for the subsequent grouting operation, either instead of a standpipe, or for down stage grouting purposes or packer grouting purposes, it shall be installed prior to the water
testing and inspections shall be made during the testing to ensure effective packer seating. Any seating leakage shall be remedied and water testing recommenced. Surface leakage through the rock, concrete and connections shall not be caulked until after completion of the test unless otherwise directed; however, the duration of the test may be reduced in such cases as directed by the Owner.

When required, multiple water tests shall be performed using double packers and gradually decreasing spacing between packers in successive tests to verify effective widths of open joints.

Water test stages on which no pressure can be built up shall be washed for a period of 5 minutes with the pump operating at full capacity, or for such period of time as fracture fillings are being removed, as evidenced by the escape of muddy water through surface openings or other grout holes.

If it is found that water used in the water test does not escape from the hole readily, the Owner may direct that an interval of at least 1 hour shall lapse between this water testing and the commencement of grouting and any water which has not escaped by then shall be removed through the bleeder valve during the first few minutes of grouting.

Pressure washing and water testing shall not be performed closer than 100 feet from holes then being grouted under pressure or that were grouted within the previous 24 hours.

C. Curtain Grouting Plinth Method and Sequence.....Curtain grouting at the plinth involves the construction of a grout curtain by drilling and grouting in successive stages in successive zones, using the down stage grouting and packer grouting procedures and split spacing method as described in the following sequence of operations. The downstream row of curtain holes in Zone 1 shall also serve as consolidation grout holes as described in Section 3.6E and as shown on the Drawings. All consolidation grouting shall be completed in a section prior to drilling and grouting the Zone 2, Zone 3, and Zone 4 curtain holes. The method and sequence described herein may be modified by the Owner as the work progresses to suit the rock conditions encountered. Refer to Part 1.2 of these Pressure Grouting Specifications.

1. All primary holes in a section shall be drilled to comparatively shallow depths within Zone 1. The depths shall be governed by the rock conditions as determined by the Owner.

2. The holes thus drilled to the depth of the first stage, shall be washed and pressure tested in accordance with Part 3.6B and shall be grouted. Unless directed by the Owner, primary holes in Zone 1 shall not be water tested prior to grouting.

3. After the grouting of any hole, the grout within the hole shall be removed by washing approximately 2 to 5 hours after grouting before it has set sufficiently to require redrilling.

4. At least 24 hours after completing the first stage grouting, the primary holes not already drilled to the limit of Zone 1 shall be drilled as
directed to additional depths not exceeding the Zone 1 limit.

5. The primary holes thus deepened shall again by washed and water tested and then grouted, using higher pressures, as directed by the Owner. Grouting shall be performed using a packer inserted in the hole and seated above but near to the bottom of the previously grouted stage. The packer shall then be withdrawn, and a standpipe connection shall be made, and grout pressure for the first stage shall be applied to the entire hole.

6. Again, the grout within the hole shall be removed as described in (c), above.

7. The process of successively drilling primary holes to additional depths and grouting at increasingly higher pressures in stages shall be repeated until all of the primary holes have been completely drilled and grouted to the depth of Zone 1 over a given section.

8. After the primary holes in Zone 1 have been completed in any section as specified above, the secondary and succeeding series holes, as determined by the split spacing method and as directed, shall be drilled and grouted to the depth of Zone 1 in like manner until Zone 1 of that section is completely grouted. Unless directed by the Owner, the secondary holes in Zone 1 shall not be water tested prior to grouting. The tertiary and succeeding series holes shall be water tested prior to grouting.

9. When all of Zone 1 drilling and grouting in a section has been completed, primary curtain grout holes (the downstream row) shall be drilled to their full depth as shown on the Drawings, or as directed by the Owner, and grouted by the packer grouting procedure. The holes shall be grouted by stages from the bottom up through a packer inserted in the hole and seated near the bottom of the higher zone or stage within a zone. After completing the last stage of packer grouting, the packer shall be withdrawn, and one stand pipe connection shall be made, and grout pressure to the first consolidation stage shall be applied to the entire hole. Unless directed by the Owner, primary holes shall not be water tested prior to grouting.

10. After grouting is completed for all primary series holes to their full depths, secondary and succeeding series holes shall be drilled to full depth and packer grouted in a like manner. Unless directed by the Owner, the secondary holes shall not be water tested prior to grouting. The tertiary holes and succeeding series holes shall be water tested prior to grouting.

11. Other sections along the grout curtain shall be grouted in like manner until grouting of the curtain is completed to the satisfaction of the Owner. When grouting is complete in a hole, the hole shall be patched by the Contractor as specified in Part 3.2C of this Section.

12. After sections of the grout curtain are completed, check holes shall be drilled to the full depth of the curtain and washed, water tested, and grouted by stages from the bottom up through a packer. The check holes shall be used to determine if additional curtain grouting is required.
It is anticipated that 6 to 8 check holes may be required.

D. Curtain Grouting Spillway Method and Sequence.....Curtain grouting at the spillway involves the construction of a grout curtain by drilling and grouting in successive stages in successive zones, using packer grouting procedures unless rock conditions require down stage grouting procedures and split spacing method as described in the following sequence of operations. The method and sequence described herein may be modified by the Owner as the work progresses to suit the rock conditions encountered. Refer to Part 1.2 of this Section of the Specifications.

1. Primary holes in a section shall be drilled to their full depth as shown on the Drawings, or as directed by the Owner, and grouted by the packer grouting procedure. The holes shall be grouted in stages by zones from the bottom up through a packer inserted in the hole and seated near the bottom of the higher zone or stages within a zone. Unless directed by the Owner, the primary holes shall not be water tested prior to grouting.

2. After grouting is completed for all primary series holes to their full depths, secondary and succeeding series holes shall be drilled to full depth and packer grouted in a like manner. Unless directed by the Owner, secondary holes shall not be water tested prior to grouting. The tertiary and succeeding holes shall be water tested prior to grouting.

3. Other sections along the grout curtain shall be grouted in like manner until grouting of the curtain is completed to the satisfaction of the Owner. When grouting is complete in a hole, the hole shall be patched by the Contractor as specified in Part 3.2C of this Section.

4. After sections of the grout curtain are completed check holes shall be drilled to the full depth of the curtain and washed, water tested, and pressure grouted by stages from the bottom up through packers. The check holes shall be used to determine if additional curtain grouting is required. It is anticipated that 4 to 6 check holes may be required.

E. Consolidation Grouting Plinth Method and Sequence.....The two rows of consolidation grout holes (the Zone 1 holes on the Drawings) in any section shall be drilled and grouted prior to commencing drilling for the deeper curtain grouting (Zone 2, Zone 3 and Zone 4 holes on the Drawings) in that section.

The grouting method and sequence shall be as described in Part 3.6C, Steps 1 to 8, inclusive.

F. Grouting Pressures.....Grouting pressures to be used in the work shall vary with conditions encountered in the respective holes and pressures used shall be as directed by the Owner. It is anticipated that pressures will range from 10 psi to 250 psi, but in no event shall pressures in excess of 30 psi, or as shown on the Drawings, be used at the top of any grout hole.

G. Grout Mixes.....The type of grout shall be neat cement grout consisting of cement and water or a cement grout with bentonite consisting of cement, water and hydrated bentonite. Mixes shall be in the proportion
as directed by the Owner and may from time to time be changed to suit the conditions found to exist in the particular grout hole. The water-cement ratio (W:C) by volume shall be varied to meet the characteristics of each hole as revealed by the grouting operation and will generally range between 3.0:1 and 0.6:1. Bentonite, when used, shall be varied to meet the characteristics of the hole as revealed by grouting operations and will generally range between 0.25 percent to 8.0 percent of the grout slurry by volume.

When bentonite is added to the grout mix, the powdered bentonite shall be hydrated in a bentonite hydration tank before the hydrated bentonite slurry is added to the grout in the high speed mixer. The powdered bentonite shall be placed in 14 parts of water by volume and gently agitated for a minimum of 2 hours to allow hydration of the bentonite.

The amount of water contained in the bentonite slurry shall be accounted for in adjusting the cement content of the grout mix to the required water-cement ratio after adding bentonite.

The viscosity and the density of the grout mix shall be checked with a marsh funnel and a mud balance by the Owner at any time to evaluate grout injectability. These tests shall be used to adjust the water, cement and bentonite content of the grout mix at the direction of the Owner.

Under no conditions shall the pressure or rate of pumping be increased suddenly.

H. Termination of Grouting. Grouting of a stage of a hole shall be considered complete when the grout take becomes less than 1 cubic foot of grout slurry in 10 minutes for the grout mix being used and the pressure drop in the hole, after valve closure, is less than 25 percent in 5 minutes.

If, due to size and continuity of a fracture, it is found impossible to reach the required pressure after pumping a reasonable volume of grout for the grout mix being used, the speed of the pumping shall be reduced or pumping shall be stopped temporarily and intermittent grouting shall be performed, allowing sufficient time between grout injections for the grout to stiffen. Following such reduction in pumping speed, if the desired result is not obtained, grouting in the hole shall be discontinued when directed by the Owner. In such event, the grout in the hole shall be washed out within 2 to 5 hours, the grout allowed to set and additional drilling and grouting shall then be done in this hole or in the adjacent area as directed until the desired resistance is built up.

After the final application of grout to a hole is finished, the pressure shall be maintained by a valve for at least 48 hours or until the grout has set to the extent that it will be retained in the hole.

I. Protection of Work and Clean Up. During grouting operations, the Contractor shall take such precautions as may be necessary to prevent drill cuttings, equipment exhaust oil, wash water and grout from defacing or damaging the permanent structures or entering a live stream.
or waste water treatment pond designed to allow discharge to a live stream. The Contractor shall furnish such pumps as may be necessary to care for waste water and grout from his operations. The Contractor shall, upon completion of his operations, clean up all waste resulting from his operations that is unsightly or would interfere with the efficient operations of the work. Clean up shall also include removal of any scaffolding and supports used to secure the drilling and grouting equipment.

3.7 OUTLET WORKS AND DIVERSION TUNNEL AND SHAFT GRouting OPERATIONS

A. General.....In order to give the Contractor an appreciation of the proposed method of work, number of operators and ancillary equipment and materials to be supplied, etc., the proposed grouting operation in the outlet works and diversion tunnel and the shaft is described in this Section. Drilling shall be done in accordance with Part 3.4 of these Pressure Grouting Specifications. Washing, water testing and grouting shall be in accordance with Part 3.5 of this Section. Definitions given in Part 3.6 of this Section also apply.

Pressure grouting in the outlet works tunnel shall consist of: (1) drilling and curtain grouting from within the tunnel before the concrete and steel linings have been placed as shown on the Drawings or as directed by the Owner, (2) drilling and crown grouting all spaces in the roof and side walls of the tunnel remaining unfilled after the placement of the concrete and steel liners as shown on the Drawings or as directed by the Owner. This drilling and grouting shall be done through pre-drilled holes in the steel lining. (3) drilling through the steel liner and interface grouting behind the steel liner in the tunnel and shaft as detailed on the Drawings and as directed by the Owner, and (4) pressure crown grouting for the tunnel plugs as shown on the Drawings and as directed by the Owner.

B. Curtain Grouting Tunnel Method and Sequence.....Curtain grouting in the tunnel involves the construction of a grout curtain by drilling and grouting the rock prior to construction of the steel and concrete linings as described in the following steps. The method and sequence described herein may be modified by the Owner as work progresses to suit the rock conditions encountered. Refer to Part 1.2 of this Section.

1. Pressure grouting of two rings of single stage grout holes (Guard Curtains) from inside the unlined tunnel followed by;

2. Pressure grouting of one ring of single stage or multiple stage grout holes (Main Curtain) from inside the unlined tunnel.

Main curtain drilling and grouting shall not commence sooner than 24 hours after the final guard curtain grout operations have been completed.

Each curtain grouting hole shall be individually grouted. If the use of multiple stages is required for the main curtain, stage lengths shall be as shown on the Drawings or as directed by the Owner.

If the use of multiple stages is required, the stage grouting procedure
shall be used, whereby drilling on a stage shall not be commenced until grouting has been completed in the previous stage of the same hole. The minimum clear time between applications of grout on successive stages shall be 24 hours. The hole shall be washed clean of grout between 2 and 5 hours after the completion of grouting of each application, except on the final application of each hole.

Unless directed by the Owner, the closure sequences of drilling and grouting as shown on the Drawings shall be adhered to. Grouting of adjoining holes of the same closure sequence, successively without delay, shall be permissible, except where the Owner directs a delay for purposes of controlling leaks or for other reasons. After drilling and grouting the primary closure sequence the grout shall be allowed to set at least 24 hours before drilling is started on the secondary closure sequence and successive closure sequences.

In those holes which are not closure grouted as directed by the Owner, drilling may be commenced in each hole, 4 hours after completion of grouting in the prior, adjacent hole.

If during the grouting of any hole, grout is found to connect to ungrouted grout holes, action shall be taken as directed by the Owner to seal any such connection as rapidly as possible, and the Contractor shall be required to wash out all holes to which grout has connected within 2 to 5 hours after grouting has been completed on the hole which caused the grout connection with the other holes.

Action shall be taken, as directed by the Owner, to minimize grout leakage into the tunnel. Such action may include caulking, reduction of pressure, additional measurements of grout take, restriction of the amount of grout applied to the hole, cessation of grouting, and/or interruptions to the continuity of the grouting and may include actual operations by the Owner or his representative of the valves on standpipe fittings.

Prior to the initial grouting of each stage of each grout hole, the Contractor shall water test the hole. The water test shall consist of the measurement of the quantity of clean water taken by the hole at a pressure of 15 psi applied at the surface or such lower pressure as directed by the Owner. The test shall be carried out for 15 minutes. Any surface leaks or connections with other holes shall not be caulked until after completion of the test unless otherwise directed by the Owner. The Owner shall keep a record of the water tests.

Grout mixes shall be in accordance with Part 3.6 of this Section.

Grouting shall be carried out at the pressures shown on the Drawings or at such other pressures as the Owner may direct, and these pressures shall be measured at the surface of the hole.

Termination of grouting in a stage and for the final grout application shall be in accordance with Part 3.6 of this Section.

When curtain grouting is complete, the holes shall be patched by the Contractor as specified in Part 3.2C of these Pressure Grouting
Specifications.

C. Crown Grouting.....The Contractor shall pressure crown grout all spaces in the roof and side walls of the tunnel remaining unfilled, after construction of the concrete and steel linings have been completed. The crown grouting shall require the drilling and grouting of grout holes through the concrete lining using pre-drilled holes in the steel lining as shown on the Drawings or as directed by the Owner. Precussion drills shall not be used to drill these holes. The pre-threaded hole shall be protected by sleeves during drilling operations. Crown grouting shall be done through grout fittings screwed into pre-threaded holes in the steel tunnel lining. Crown grouting of any section of the tunnel shall be completed to the satisfaction of the Owner before the commencement of any interface grouting in that section.

Crown drilling and grouting shall not be performed until the concrete lining has attained 80 percent of its design strength as determined by the Owner.

Crown grout holes shall be individually water tested before grouting. Only sufficient water shall be injected to determine whether the hole is taking water and to determine connections between holes. All crown grout holes adjacent to the hole being water tested shall be uncapped during the water test and during grouting to facilitate the escape of air and water. Where grout is found to flow from adjacent uncapped grout holes in sufficient quantity to interfere seriously with the grout operations or to cause appreciable loss of grout, such connections shall be temporarily capped as directed by the Owner.

Crown grout holes showing takes in the water test shall be individually grouted. Holes not showing takes in the water test may be grouted in groups of not more than four holes.

Grout having a water to cement ratio of nought point eight to one (W:C=0.8:1 by volume) shall be injected at a pressure of 30 psi or less as directed by the Owner. Pressure shall be held on the grout for 30 minutes, and all holes shall be frequently bled to remove all thin grout, air and water. After grouting, valves shall be left closed on each grouted hole for at least 4 hours.

When crown grouting is complete in a section of the tunnel, the holes shall be plugged by the Contractor as shown on the Drawings.

D. Interface Grouting.....Interface grouting shall comprise the grouting of all spaces between the steel liner and the concrete surrounding the steel liner. Areas requiring grouting shall be determined by the Owner by tapping the liner with a hammer to detect voids or by other methods determined by the Owner. Interface grouting of any section shall not commence until all crown grouting in the section of tunnel has been completed to the satisfaction of the Owner.

Interface grouting shall be implemented through grout fittings screwed into threaded holes drilled in the liner. The Contractor shall drill and thread the required number of interface grout holes as directed by the Owner and as shown on the Drawings. All connections of grout
fittings to the threaded holes shall be air tight.

The grout fittings shall be beveled at the outlet end and set so that grout can flow freely therefrom to the void between the concrete lining and the steel lining. The grout pipes shall be installed in such a manner that the hole can be plugged as shown on the Drawings.

Grout having a water to cement ratio of nought point eight to one (W:C=0.8:1 by volume) shall be injected at pressure of 30 psi, or less as directed by the Owner. Pressures shall be held on the grout for 30 minutes, and all holes shall be frequently bled to remove all thin grout, air and water. Valves shall be left closed on each grout pipe for at least 4 hours.

Interface grout holes adjacent to a grout hook-up shall be left open during the grouting operations to facilitate the escape of air and water from the space surrounding the steel tunnel lining. Where grout is found to flow from adjacent grout connections in sufficient quantity to interfere seriously with the grouting operations or to cause appreciable loss of grout, such connections shall be temporarily capped as directed by the Owner.

E. Tunnel Plug Grouting.....The Contractor shall pressure crown grout all spaces in the roof and side walls of the tunnel plugs remaining unfilled after placement of the concrete tunnel plugs. The grouting shall be carried out through pipes installed prior to placing the concrete as shown on the Drawings or as directed by the Owner.

Crown grouting shall not be performed until the concrete tunnel plug has attained 80% of its design strength as determined by the Owner.

All grout connections adjacent to the connection being grouted shall be uncapped during grouting to facilitate the escape of air and water. Where grout is found to flow from adjacent uncapped connections or in other areas in sufficient quantity to interfere seriously with grouting operations or to cause appreciable loss of grout, such connections shall be temporarily capped or caulked as directed by the Owner.

Grout having a water to cement ratio of nought point eight to one (W:C 0.8:1 by volume) shall be injected at a pressure of 30 psi or less as directed by the Owner. Pressures shall be held on the grout for 30 minutes, and all connections shall be frequently bled to remove all thin grout, air and water. After grouting, valves shall be left closed on each connection for at least 4 hours.

When grouting is complete the connections shall be plugged by the Contractor as shown on the Drawings or directed by the Owner.

F. Protection of Work and Clean Up.....During grouting operations, the Contractor shall take such precautions as may be necessary to prevent drill cuttings, equipment, exhaust oil, wash water and grout from defacing or damaging the permanent structures or entering a live stream or waste water treatment pond designed to allow discharge to a live stream. The Contractor shall furnish such pumps as may be necessary to care for waste water and grout from his operations. The Contractor
shall, upon completion of his operations, clean up all waste resulting from his operations that is unsightly or would interfere with the efficient operations of the work. Clean up shall also include removal of any scaffolding and supports used to secure the drilling and grouting equipment.

3.8 MISCELLANEOUS GROUTING OPERATIONS

A. General. Drilling and pressure grouting miscellaneous grout holes, including feeler and pilot holes ahead of underground excavations, includes all drilling and pressure grouting of such holes as directed by the Owner in accordance with the provisions of Part 1.2 of these Pressure Grouting Specifications.

B. Procedures. The procedure adopted for the above drilling and grouting shall be generally in accordance with those required for curtain grouting Part 3.6 of these Pressure Grouting Specifications, or as otherwise directed by the Owner. The grouting pressure to be applied shall be 30 psi, or such pressure as directed by the Owner. Drilling shall be done in accordance with Part 3.4 of these Pressure Grouting Specifications. Washing, water testing and grouting shall be done in accordance with Part 3.5 of these Pressure Grouting Specifications.

When directed by the Owner, feeler or pilot holes shall be drilled with percussion type drills ahead of underground excavations to determine in advance the nature of the materials to be excavated or the existence of water-bearing seams or strata or for the purpose of grouting. The minimum length of feeler or pilot holes shall be 15 feet and a maximum length of 40 feet may be required. The diameter of each hole shall be not less than 1.5 inches. The location, direction, length and number of holes shall be as directed by the Owner. When feeler or pilot holes are required to be drilled in the tunnel and shaft excavations, other operations shall be suspended or modified as may be necessary to permit such drilling and grouting and the Contractor shall not be entitled to any additional compensation or extension of time on account of such requirement.

Nothing contained in this Section of these Specifications shall prevent the Contractor at his own expense from drilling feeler or pilot holes ahead of the underground excavation as he may consider necessary.
C. Protection of Work and Clean Up.....During grouting operations, the Contractor shall take such precautions as may be necessary to prevent drill cuttings, equipment, exhaust oil, wash water and grout from defacing or damaging the permanent structures or entering live streams or waste water treatment ponds designed to discharge into a live stream. The Contractor shall furnish such pumps as may be necessary to care for waste water and grout from his operations. The Contractor shall, upon completion of his operations, clean up all waste resulting from his operations that is unsightly or would interfere with the efficient operations of the work. Clean up shall also include removal of any scaffolding and supports used to secure the drilling and grouting equipment.

End of Section
SECTION 2E - DAM INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION OF THE WORK

A. The work in this section shall include all labor, material, and equipment required for furnishing, installing, and maintaining embankment surface monuments and crest wall monuments for the dam embankment and for furnishing, installing, and maintaining control monuments in the dam abutments as shown on the Drawings.

B. The work in this section shall be coordinated with embankment placement and crest wall construction.

C. During the progress of the work, it may be necessary or desirable to vary the number and/or location of embankment surface monuments, crest wall monuments, or abutment control monuments based on actual field conditions.

1.2 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established firms. All labor for installation shall be continuously supervised by persons well versed and experienced in this work to ensure proper and adequate installation of these materials.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted as specified in Section 1.D of the General Requirements.

1.4 PRODUCT HANDLING

The Contractor shall use all means necessary to protect these materials before, during, and after installation. In the event of damage, all necessary repairs or replacements shall be made at no additional cost to the Owner. The decision to repair or replace these materials shall be the responsibility of the Owner.

PART 2 - PRODUCTS

2.1 EMBANKMENT SURFACE MONUMENTS AND ABUTMENT CONTROL MONUMENTS

Embankment surface monuments shall consist of brass caps riveted to galvanized pipe.

2.2 CREST WALL MONUMENTS

Crest wall monuments shall consist of brass caps with barbed anchors.
2.3 GALVANIZED PIPE

Galvanized pipe shall have the lower portion of the pipe flared as shown on the Drawings. Diameter of pipe shall be determined by size of brass cap furnished.

2.4 CONCRETE

Concrete for concrete pedestals as shown on the Drawings shall conform to Division 3 of these Specifications. The concrete shall be Class B.

PART 3 - EXECUTION

3.1 The embankment surface monuments and the abutment control monuments shall be installed within two weeks after the dam embankment has reached elevation 6705. The crest wall monuments shall be installed concurrently with the concrete placement of the crest wall. After installation of all monuments, the Contractor shall conduct the remainder of his operations in the area in such a manner that the monuments are not disturbed or damaged. Any monument that is disturbed or damaged due to the Contractor's operations shall be replaced or repaired as directed by the Owner at no additional cost to the Owner.

3.2 It shall be the responsibility of the Owner to determine the horizontal and vertical location of each monument at the time of monument installation. Any resurveying required due to monument damage or disturbance caused by the Contractor operations shall be paid for by the Contractor.

End of Section
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This work shall consist of furnishing all equipment, materials, and manpower required and of performing all operations required to be performed in accordance with required fill placement, including but not limited to preparation of the dam and cofferdam embankment foundations, placement of the dam embankment, placement of the cofferdam embankments, and placement of backfill for the intake and outlet structures of the outlet works, and miscellaneous structures.

The work includes:

1. Impervious material in Zone 1 of the dam embankment placed against the concrete face.
2. The random fill, Zone 4, of the dam embankment placed against the Zone 1 material.
3. The transition material, Zones 2 and 2A, of the dam embankment.
4. Compaction and sealing of dam embankment upstream face over Zone 2 and 2A of the dam embankment.
5. The rockfill, Zones 3A and 3B, of the dam embankment.
6. The earthfill, Zone 1, of the cofferdam embankments.
7. The miscellaneous fill, Zone 5, of the cofferdam embankments.
8. The riprap on the upstream slope of the upstream cofferdam and on the downstream slope of the downstream cofferdam.
9. The horizontal drainage blanket for the upstream cofferdam.

1.2 QUALITY ASSURANCE

The dam embankments and backfill shall be constructed to the lines, grades, and dimensions shown on the Drawings provided that, at any time prior to or during construction, the Owner may vary the division lines between zones of the dam embankments and also the position of the outside faces of the dam embankments. The Owner shall conduct such tests of the fill placement as he considers necessary to ensure that the fill placement meets the requirements of these Specifications.

1.3 DEFINITION OF MATERIALS

For purposes of these Specifications, the materials to be used for fill placement are defined in Part 1.4 of Section 2C of these Specifications.
PART 2 - PRODUCTS

(No Products)

PART 3 - EXECUTION

3.1 ROCKFILL IN MAIN DAM

A. General....The dam embankment shall be constructed in accordance with the provisions of this part of the Specifications. The embankment shall be constructed to the lines, grades, and dimensions shown on the Drawings provided that, at any time prior to or during construction, the Owner may vary the division lines between zones of the dam embankment and also the position of the outside faces of the dam embankment.

The upstream face of the embankment shall be finished in accordance with Subpart G of this Part of the Specifications. The downstream face of the dam embankment shall, when completed, present an appearance of uniform texture and general smoothness.

The Contractor's proposed methods for producing and placing transition material, for compacting and sealing the upstream face prior to placing the concrete face slab, and for working the spillway excavation and quarry shall be in accordance with the Borrow Area Management Plan.

B. Embankment Tolerances....Embarkment materials shall not encroach into adjacent zones further than allowed by the following tolerances measured perpendicular to the dam control line, and in a horizontal plane from the division lines shown on the drawings or adjusted by the Owner, provided that the width of Zones 2 and 2A shall be constructed to not less than the minimum widths shown on the Drawings.

<table>
<thead>
<tr>
<th>LINE</th>
<th>TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division lines between Zones</td>
<td></td>
</tr>
<tr>
<td>Zones 2 and 3A</td>
<td>2 ft.</td>
</tr>
<tr>
<td>Zones 3A and 3B</td>
<td>4 ft.</td>
</tr>
<tr>
<td>Downstream face of dam embankment</td>
<td>zero</td>
</tr>
<tr>
<td></td>
<td>2 ft.</td>
</tr>
</tbody>
</table>

The upstream face of the dam shall be trimmed within the following tolerances from the lines shown on the Drawings, measured normal to the face.
Towards Dam Control Line | Away from Dam Control Line

Upstream face of dam embankment | zero | 6 in.

Except as otherwise approved by the Owner, the differential height between adjacent zones measured after compaction at the division line between zones shall be maintained within the following limits:

Elevation of Zone 3A above Zone 2
- plus ... 3 ft.
- minus ... zero

Elevation of Zone 3B above Zone 3A
- plus ... 3 ft.
- minus ... zero

C. Preparation of Foundations

The suitability of each part of the dam foundation for placing embankment materials thereon shall be determined by the Owner. Materials shall not be placed in any part of the dam embankment until the foundation for that part has been dewatered, cleaned up, and suitably prepared and has been approved by the Owner.

1. Plinth Foundations

The excavation for the plinth foundation shall be conducted in accordance with the requirements of Parts 3.1 and 3.2 of Section 2C of these Specifications. Seams and other defects below the general level of the plinth foundation shall, where directed, be excavated to the lines, depths, and dimensions directed by the Owner.

Irregularities, fissures, or open joints in otherwise sound rock shall be slush grouted with a sand-cement grout if said irregularities, fissures, or open joints cannot be effectively treated as determined by the Owner using Class C concrete. Slush grouting shall be carried out in such a manner as to provide a suitable surface on which to place the foundation concrete for the plinth. The slush grout to be used shall consist of 3 parts sand and 1 part of cement by weight and the minimum amount of water required for proper placement as approved and directed by the Owner. Cement, sand, and water shall comply with the requirements in Division 3 of these Specifications. The cement and sand shall be thoroughly mixed in a dry condition and the water then added.

Prior to the application of slush grout to the plinth foundation, open fractures and surface irregularities shall be cleaned thoroughly with air and water jets and hand equipment where necessary. Placement of slush grout shall not take place until the plinth excavation has been inspected and approved by the Owner. The foundation shall be wet at the time of the placement of the slush grout but ponded water shall not be permitted where the grout is being placed.

The slush grout shall be thoroughly spaded or troweled into the deeper portions of the fractures or cavities exposed in the plinth excavation. Any segregation of the grout material shall be removed by reworking the grout on the foundation. Following the filling of the deeper portions, the surface portions of fractures or cavities shall have slush grout worked into them using stiff brooms. Grout shall be placed within 1/2 hour of mixing. The slush grout shall be cured by a method approved by the Owner.
Just prior to placing concrete in the plinth, a final clean up of the rock or concrete surfaces against which the concrete is to placed shall be made by barring, wedging, and picking or by other effective means to remove all loose, shattered, disintegrated, overhangs, and other objectionable materials and all water shall be removed from depressions. The final foundation surface shall then be cleaned by brooming or with jets of air and shall be wetted immediately prior to the placement of the concrete. The Owner shall give his written approval prior to the placement of concrete in the plinth.

2. Rockfill Foundations.....The excavation for the rockfill foundations shall be made in accordance with the requirements of Parts 3.1 and 3.2 of Section 2C of these Specifications.

Where, within 50 feet downstream of the plinth, it is not practicable to excavate local overhanging rock faces, the rock face shall be solidly faced with Class C concrete to provide abutment contact slopes between vertical and 0.25 horizontal to 1 vertical as determined by the Owner.

For a distance downstream of the plinth equal to one-half the difference in elevation of the minimum pool (elevation 6,500) and the elevation of the plinth, the treatment of seams and joints shall be as specified for the plinth foundation. This foundation treatment shall only extend to the elevation of the minimum pool (elevation 6,500).

For a further distance downstream equal to that specified above, seams and other defects below the general level of the foundations shall be excavated as directed by the Owner and solidly filled or covered with Zone 2A material.

Over the remainder of the rockfill foundation, where the foundation rock in local areas is other than moderately weathered to fresh rock, such rock shall be covered with a 2-foot thick layer of Zone 2 materials as directed by the Owner.

Under Zone 3A rockfill, overhangs shall be trimmed back to the point where proper compaction of the rockfill shall not be impeded. Within 50 feet downstream of the plinth reference line, overhangs shall be cut back to a slope of between vertical and 0.25 horizontal to 1 vertical or as directed by the Owner.

D. Zone 1-Impervious Fill

1. Materials.....Materials for Zone 1 of the main dam embankment shall consist of a selected impervious mixture of soils from required excavation, stripping, and borrow areas. Rock fragments having a maximum dimension of more than 3 inches shall not be permitted in Zone 1 of the embankment and shall be removed at the site of excavation. The properties of the material when compacted in the embankment shall be as follows:

   a. The gradation, as determined in accordance with ASTM D-422, shall be such that not less than 80% shall pass the No. 4 sieve and not less than 40% shall pass the No. 200 sieve.
b. The plasticity index, as determined in accordance with ASTM D-424, shall be not less than 12%.

The borrow areas shall be operated in accordance with the provisions of Part 3.1E of Section 2C of these Specifications.

The Contractor shall select material for use in Zone 1 at the source, using such testing as he considers necessary to establish the suitability of the material. The results of all testing shall be submitted to the Owner on a weekly basis.

The Owner shall test samples of material, taken from the dam embankment after compaction, to determine their suitability for Zone 1 of the embankment. The Contractor shall remove or recondition material that does not meet the requirements of these Specifications, at no additional cost to the Owner.

2. Foundation Preparation.....Materials shall not be placed in any part of Zone 1 of the dam embankment until the foundation for that part has been dewatered, cleaned up and has been approved in writing by the Owner.

3. Placing of Zone 1 Material.....The Contractor's operations for handling, spreading, and compacting Zone 1 material on the dam embankment shall produce an acceptable distribution and gradation of the materials throughout the zone, free of lenses, streaks, laminations, layers of the material differing substantially from the surrounding material in the zone, or other discontinuities. The density shall be uniform throughout each compacted layer. Rock pockets and clusters of rock which would interfere with the proper compaction of the material shall not be permitted.

Zone 1 material placed against the upstream concrete face shall be sloped away from the contact surface for a distance of at least 10 feet at an inclination of 6 horizontal to 1 vertical or steeper to allow for direct compaction of the material against the contact surface.

The material shall be placed in Zone 1 in continuous, approximately horizontal layers of not more than 12 inches in thickness after being compacted from abutment to abutment for the full width of the zone as herein specified.

Unless otherwise approved or directed by the Owner, the material in each layer of Zone 1 shall have a moisture content, during and after compaction, as determined by ASTM D-226 within the range of optimum moisture content to 3% above optimum moisture content and the moisture content shall be uniform throughout the layer. The optimum moisture content of the material shall be that moisture content which is required to produce the maximum dry density when compacted in accordance with ASTM D-698. The moisture content and the optimum moisture content of Zone 1 material that is placed in the embankment shall be determined by the Owner from selected samples. If the moisture content, as determined from the samples, does not fall within the required limits, the Contractor shall treat the material in such a manner that the moisture content is brought within the required limits as indicated by a further series of tests.
If, in the opinion of the Owner, the surface of the prepared foundation or the surface of any layer of Zone 1 material is too dry or smooth to bond properly with the layer of material being placed thereon, it shall be moistened if necessary, and worked with harrow, scarifier or other suitable equipment in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the next layer of Zone 1 material is placed.

When each layer of material has been conditioned to have the specified moisture content, it shall be compacted until the dry density is at least 95% of the maximum dry density obtained from the compaction tests carried out in accordance with ASTM D-698. If the Zone 1 material cannot be brought to the specified moisture content, it shall be removed from the dam embankment.

E. Zones 2 and 2A-Transition Material -

1. Materials.....All transition materials required for Zones 2 and 2A of the dam embankment shall be obtained from required excavation in the spillway, or other sources as approved by the Owner. The material for Zones 2 and 2A shall consist of a non-plastic mixture of fresh rock fragments in which the individual particles are hard and durable and free from clay, silt, and organic material. Only hard, slightly weathered to fresh crystalline rock shall be selected for processing.

The material in transitions Zones 2 and 2A, when placed and compacted, shall be crusher run sized between the limits given below:

<table>
<thead>
<tr>
<th>Transition Material Zone</th>
<th>Maximum Particle Size (inches)</th>
<th>Maximum Percentage by Mass Finer Than 0.074 mm (#200 Sieve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

The gradation shall be determined in accordance with ASTM D-422.

Materials for Zones 2 and 2A shall be processed, if required, to achieve the required quality and gradings. Such processing may involve, but shall not necessarily be restricted to a combination of screening, crushing, washing, separating, and reblending.

The Contractor shall provide the necessary plant for processing the materials required for the transition Zones 2 and 2A in the dam embankment. Not less than 30 days prior to the erection of the plant, the Contractor shall submit drawings for approval by the Owner showing the proposed general arrangement for the plant, together with a description of the equipment proposed to be used. The Owner shall approve the proposed plant prior to its mobilization to the site by the Contractor.

2. Placing of Transition Material.....Before compaction, material in Zones 2 and 2A shall be placed and spread to an approximately horizontal surface in such a way to prevent segregation of particles or formation of voids. The thickness of each layer shall be not more than 6 inches
for Zone 2A and 12 inches for Zone 2 after the required compaction. Blending of zones on the dam embankment in order to produce the required grading shall not be permitted except that the Owner may direct blending to correct any segregation as a result of placing or spreading.

The Owner may direct that Zones 2 and 2A materials shall be placed in the dam embankment in locations other than the areas shown on the Drawings where defects or other more weathered material occur in the foundations.

Not less than 30 days before the start of placing Zones 2 and 2A in the dam embankment, the Contractor shall submit to the Owner for approval details of his proposed method of placing the materials and the equipment he proposes to use.

The Owner shall carry out gradation tests to control the quality of the transition material. These tests shall be carried out on samples taken: (a) after processing, but prior to placement in the dam embankment and; (b) after compaction in the dam embankment.

Representative tests shall be carried out at the rate of one per 2,000 cubic yards of placed material. The gradation tests shall be conducted in accordance with ASTM D-422.

Before placement of the Zones 2 and 2A material in the embankment, the Owner shall test the material in accordance with ASTM C-131. The material will be rejected if the loss using Grading A in the Los Angeles abrasion test exceeds 45% by weight at 500 revolutions. The material shall also be rejected if the portion retained on a No. 50 sieve, when subjected to five cycles of the sodium sulfate test for soundness in accordance with ASTM C-88, shows a weighted loss of more than 14% by weight.

The Contractor shall remove or recondition material that does not meet the requirements of this Section.

Each layer of Zone 2 material shall be compacted by four passes of a vibrating roller conforming to the requirements for vibrating rollers for rockfill as specified in Part F of this Section of the Specifications. Particular care shall be taken to prevent damage to the concrete or to the water stops embedded in the plinth concrete. Where required, the Owner may direct special compaction as provided in this Subpart of this Section of the Specifications. When the material is placed adjacent to concrete structures, the requirements of Part 3.3 of this Section of the Specifications shall also be observed.

3. Special Compaction-Zone 2A.....Adjacent to foundations of structures and to the plinth where compaction of materials by means of rollers or tractor treads is impracticable or undesirable as determined by the Owner, such material shall be specially compacted as specified herein. All equipment and methods used shall be approved by the Owner.

The differential height between material being specially compacted in any zone and the adjacent material not requiring special compaction shall be no greater than 1 foot, and the material specially compacted
shall be higher than the adjoining material.

Zone 2A material requiring special compaction shall be deposited in approximately horizontal layers of not more than 8 inches in thickness and shall be compacted by mechanical tampers, or other methods approved by the Owner, to a density equivalent to that achieved by the compactive effort specified above.

4. Zone 2 material shall be used for backfilling near structures as shown on the Drawings and as directed by the Owner. The material shall be placed in 12-inch layers after compaction. The material shall be compacted by equipment approved by the Owner in accordance with Subsection 3.1P.3 (Special Compaction-Zone 2A) of this Section of the Specifications.

F. Zones 3A and 3B - Rockfill -

1. Materials.....All materials required for rockfill in Zones 3A and 3B of the dam embankment shall be obtained from the required excavation in the spillway or other sources approved by the Owner.

All excavation for Zone 3A and 3B material shall be carried out in accordance with Sections 3.1, 3.4, and 3.6 of Section 2C of these Specifications. Material for Zones 3A and 3B shall consist of a mixture of hard durable rock fragments obtained from slightly weathered to fresh crystalline rock. The rock shall be unaffected by chemical alteration and shall not break down significantly under the action of the rollers.

The material for Zones 3A and 3B shall, when placed and compacted, be well-graded and shall be such that the maximum rock size shall not be less than 6 inches nor greater than that which can be encompassed in either:

a. A 4-foot layer for Zone 3A except for the face of Zone 3A in contact with Zone 2 which shall be placed and compacted in a 2-foot layer.

b. An 8-foot layer for Zone 3B; without interfering with satisfactory compaction.

Zones 3A and 3B rockfill shall contain no more than 10% finer than 0.074 mm (#200 sieve) after compaction.

The Owner shall carry out gradation tests to control the quality of the Zone 3A rockfill material. These tests shall be carried out on samples taken:

a. After quarrying or excavation prior to placement in the dam embankment.

b. After compaction in the dam embankment.

Six representative tests shall be conducted in accordance with ASTM D-422.

The Contractor shall remove or recondition material that does not meet the requirements of these Specifications at no additional cost to the
Owner.

2. Placing of Rockfill.....Before compaction, materials in Zones 3A and 3B shall be placed and spread to an approximately horizontal surface in such a way as to prevent segregation or the formation of voids. The thickness of each layer after compaction shall be 4 feet for material in Zone 3A except for the face of Zone 3A in contact with Zone 2 which shall be placed and compacted in a 2-foot layer and 8 feet for material in Zone 3B. The Contractor shall place the best quality rock for Zone 3A towards the zone boundary with Zone 3B and the best quality rock for Zone 3B towards the downstream face. The Contractor shall ensure that when placing Zone 3B material in the downstream face of the dam embankment, the larger rock fragments are worked to the outside face to achieve a uniform and stable protective surface.

Each layer of the material in Zones 3A and 3B shall be compacted by four passes of a vibrating roller as specified in this Subpart of the Specifications. One pass of the roller is defined as the required number of successive trips which by means of sufficient overlap will ensure complete coverage of an entire layer by the roller. The Owner shall have the option of increasing the number of roller passes if required by the settlement measurement. The vibrating rollers shall meet the following requirements:

a. The static mass of the roller in operating condition, transmitted to the ground through the surface of the drum shall not be less than 10 tons.

b. The centrifugal force generated by the vibrating part of the roller shall not be less than 27 tons at the maximum frequency permitted by the manufacturer for continuous operation of the roller.

The operation of the vibrating rollers, including frequency of vibration and speed of travel, shall be as directed by the Owner. If more than one vibrating roller is used, all rollers shall be of the same type and essentially the same dimensions. Tractors shall have sufficient power to pull the rollers at the speed determined by the Owner under all conditions encountered on the dam embankment. The surface of the rollers shall be kept free of adhering material. The rollers shall be properly maintained to insure that they retain consistent compaction characteristics.

3. Settlement Measurements.....The Owner shall require several series of settlement measurements to determine the effectiveness of vibrating roller compaction. Each series of settlement measurements will be made on a test area of approximately 200 square yards on the surface of the rockfill. In each series, measurements will be made of the elevation of selected points in the test area before rolling, and after each succeeding pass of the vibrating roller up to a maximum of 12 passes. The location of the test areas and the measurement points, will be selected by the Owner and all measurements will be made by the Owner. The cost of the work required for the settlements shall be included in the rates bid on the Bid Form for placing and compacting material in Zones 3A and 3B.

G. Compaction and Sealing of Dam Embankment Upstream Face -
1. Compaction....The upstream face of the dam embankment shall be compacted and sealed in accordance with this part of the Specifications as construction of the embankment proceeds. The slope length of the section being treated shall not be less than 20 feet nor greater than 75 feet.

Before face compaction is carried out, the upstream face of the embankment shall be trimmed to within the required tolerances specified in Part 3.1B of this Section of the Specifications. Where additional material is required, Zone 2A material shall be used. If the thickness of such material is greater than 6 inches, compaction shall be carried out in layers in accordance with Part 3.1E.2 of this Section of the Specifications.

Face compaction, as specified herein, shall be carried out using a vibratory roller as specified in Part 3.1F.2 of this Section of the Specifications. A pass, as specified in this part, shall consist of an upslope movement of the roller with or without vibration or with half vibration as specified. No vibration shall take place during downslope movements. "Half vibration" shall mean operating the engine causing vibrations at half its maximum speed.

After trimming has been completed, the upstream face of the embankment shall be compacted with a minimum of four passes of the roller with full vibration. Prior to commencing compaction of the face, the Contractor shall conduct trials to determine the minimum number of passes of the roller without vibration and with half vibration necessary before the face can be compacted at full vibration without material tending to rill down the face under the roller. Zone 2A material shall be added as necessary to produce a surface in which hollows shall not be greater than 3 inches over any 20-foot length. All Zone 2A material added shall receive compaction by at least four passes of the roller at half vibration. Overlapping of passes shall be carried out as directed by the Owner to insure that the whole area receives the required compaction. Within 4 feet of the plinth, mechanical rammers or other means approved by the Owner shall be used.

2. Sealing....After completion of face compaction, the upstream face of the embankment shall be sealed by treatment with a cationic bituminous emulsion and aggregate. Full compaction of the face may be completed before or after sealing the face. The cationic bituminous emulsion and aggregate seal shall be as follows:

a. One prime coat consisting of cationic bituminous emulsion diluted by the addition of not less than 20% nor more than 50% water shall be applied at the rate of 0.4 gallons per square yard. This rate may be varied by the Owner.

b. When the prime coat is thoroughly dried and cured, a seal coat of cationic bituminous emulsion shall be applied at the rate of 0.4 to 0.8 gallons per square yard as directed by the Owner. As soon as practicable, after placing the bituminous emulsion, the face shall be covered with a dust-free No. 4 aggregate at the rate of 1 cubic yard per 200 square yards of surface. The seal shall be rolled with one pass of the roller without vibration.
c. Not less than 24 hours after application of the first seal coat, the surplus No. 4 aggregate shall be broomed from the surface and the surface shall then be given a second seal coat of bituminous emulsion and aggregate and rolled as specified above.

Any final compaction of the upstream face shall be completed between 12 and 24 hours after sealing with the bituminous emulsion.

The Owner may order additional passes of the vibrating roller, without vibration, with half vibration or with full vibration after any stage in the compaction and sealing process.

H. Zone 4—Random Fill Dam Embankments

1. Materials....The random fill for the dam embankment shall consist of miscellaneous mixtures of rock, clay, silt, sand, gravel, and cobbles obtained from required excavations or the borrow areas. Occasional boulders and rock fragments larger than 12 inches in maximum dimensions not sufficient to cause interference with compaction may be embedded in the Zone 4 embankment.

2. Foundation Preparation....No special foundation preparation is required.

3. Placing of Zone 4 Material.....Zone 4 material shall be placed in uniform lifts approximately 2 feet in thickness prior to compaction. The moisture content of the Zone 4 material prior to and during compaction shall be distributed uniformly throughout each layer of the material. The moisture content of the material shall range between 4% dry of the standard optimum moisture content and 4% wet of the standard optimum moisture content. The dry density of the material after compaction shall be greater than 90% of standard Proctor density. Material not meeting these requirements shall be removed, conditioned and replaced at no additional cost to the Owner.

3.2 COFFERDAMS

----------

A. General....The upstream and downstream cofferdams shall be constructed in accordance with the provisions of this Section of the Specifications. The embankments shall be constructed to the lines, grades, and dimensions established by the Owner which, in general, will be those shown on the Drawings provided that, at any time prior to or during construction, the Owner may vary the division lines between zones of the dam embankment and also the position of the outside faces of the cofferdam embankments. In general, the cofferdams may be constructed as homogeneous embankments utilizing all Zone 1 material or may be constructed as zoned embankments using a Zone 5 random fill as shown on the Drawings.

B. Foundation Preparation.....The foundation for the Zone 1 of the cofferdam embankments shall be prepared in accordance with the requirements of Section 3.1D of this Section of the Specifications.

C. Materials....The Zone 1 portion of the cofferdam embankments shall meet the requirements of Part 3.1D of this Section of the Specifications.
The Zone 5 portion of the cofferdam embankments shall meet the requirements for Zone 1 or the requirements for Zone 4 random material as specified in Part 3.1H of this Section of the Specifications at the Contractor's option.

The material for the horizontal downstream drainage blanket in the upper cofferdam shall meet the requirements for Zone 2A material in Part 3.1E of this Section of the Specifications.

The material for riprap and bedding for riprap protection of the cofferdams shall have the following properties:

1. The bulk specific gravity of the material as determined in accordance with ASTM C-127 shall be equal to or greater than 2.55.

2. The weight loss of the material as tested under ASTM C-88 for five cycles sodium sulfate soundness shall be 10% or less.

3. The weight loss of the material when tested for resistance to abrasion in accordance with ASTM C-535 shall be 35% or less.

4. The weight loss of the material when tested for resistance to disintegration by freezing and thawing in accordance with AASHTO T-103 shall be 5% or less.

5. The bedding material shall consist of a reasonably graded, pervious mixture of sizes ranging from the U.S. No. 4 screen to 3 1/2 inches.

6. The riprap material shall consist of a reasonably graded, pervious mixture of sizes ranging from 6 inches to 18 inches.

The Contractor's operations shall be such that he will handle and place the bedding material in such a manner as to prevent segregation. The bedding need not be compacted in-place, but shall be placed in such a manner as will result in uniform layers of bedding of the specified thicknesses.

The riprap need not be compacted but shall be placed to grade in a manner to insure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger fragments in such a manner as will result in a well keyed, densely placed, uniform layers of riprap of the specified thickness. The completed riprap shall be stable, without tendency to slide. The Contractor will be required to maintain the riprap until the completion and acceptance of all work under this Contract.

End of Section
SECTION 2G - WASTE MATERIAL DISPOSAL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work to be Performed.....The work shall consist of furnishing all equipment, materials, and manpower required and of performing all operations required to be performed in accordance with disposing of all materials from required excavation which are unsuitable for, or which are not required for construction. The materials shall be disposed of or stockpiled in accordance with the provisions of this Section of the Specifications in the designated disposal areas shown on the Drawings, or in other locations in the vicinity of the construction as approved by the Owner.

B. Applicable Laws.....The Contractor shall comply with DEQ Bury Permits and all applicable local, State, and Federal laws and regulations pertaining to disposal of waste materials.

PART 2 - PRODUCTS

(No Products)

PART 3 - EXECUTION

3.1 SPECIAL CONDITIONS

The disposal of surplus materials from dam stripping and excavation, spillway stripping and excavation, tunnel excavations, quarry stripping, waste area stripping, borrow area stripping, and any other miscellaneous excavation shall be made in the designated disposal areas upstream of the upstream cofferdam and below elevation 6675.

3.2 WORKMANSHIP

Excavated materials shall be disposed of so as not to interfere with the operation of any facilities and disposal and stockpile areas shall be generally leveled and trimmed to reasonably regular lines to the satisfaction of the Owner.

Excavated materials disposed of or stockpiled adjacent to Deer Creek and its tributaries shall be adequately protected from erosion by surface runoff or by stream action. This protection shall include but not be restricted to flumes, culverts, and drains around or through such disposal and stockpile areas. Discharge of runoff from waste disposal areas into Deer Creek or its tributaries shall not be allowed.

Disposal areas shall be cleared in accordance with Section 2B of the Specifications. Grubbing of disposal areas shall not be required.

The Contractor shall submit to the Owner for approval, a proposal for disposal of materials in any area and the protection of these materials from erosion at least 30 days prior to commencement of disposal in the area. This proposal shall state the maximum batter slope to which the
material shall be placed to insure stability. The proposal shall be in accordance with the Borrow Area Management Plan.

End of Section
SECTION 2H – CHAIN LINK SECURITY FENCE AND ACCESS CONTROL GATE  
PART 1 – GENERAL

A. General....Work shall include furnishing all materials, labor, equipment, and incidentals necessary for construction of this item. Chain link security fence, chain link gate, and access control gate shall be constructed in accordance with these specifications and in conformity with the lines and grades shown on the drawings or established in the field by the Owner.

B. Related Work Described Elsewhere....Concrete Division 3.

1.2 QUALITY ASSURANCE

A. Manufacturers....All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials shall conform to the latest standard specifications--ANSI, ASTM, AWS, etc. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern. The work in this section shall be performed by experienced craftsman, well-versed and (where applicable) certified in the grades involved, and under the direction of competent supervisors to ensure proper and adequate installation of these materials.

B. Source....All items for the chain link security fence and chain link gate shall be furnished and coordinated by one fabricator or manufacturer.

1.3 SHOP DRAWINGS

A. Shop Drawings.....Before any security fence or gate materials are delivered to the site, shop drawings must be submitted in accordance with the General Requirements, Part 1.D and must be approved by the Owner. Shop drawings shall include all dimensions, details, corner sections, end sections, special sections, splicing, layout, and installation procedures.

B. Proof of Compliance.....Contractor shall deliver to Owner a letter certifying the material furnished complies with the requirements of these specifications.

1.4 PRODUCT HANDLING

A. Protection.....All means necessary shall be used to protect the materials before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements shall be made to the approval of the Owner and at no additional cost to the Owner.
PART 2 - PRODUCTS

2.1 CHAIN LINK FENCE, POSTS, AND REQUIRED FITTINGS AND HARDWARE

A. General....Chain link fabric, posts, and required fittings and hardware shall conform to the requirements of AASHTO M 181, latest revision, except that the chain link fabric may conform to ASTM A 392 Class 1 coating.

B. Material Characteristics.....The materials used shall conform to the requirements specified in the "General Notes" shown on the chain link fence drawing.

With the exception of the chain link fabric, all ferrous metal used in the construction of the fence shall be hot-dip zinc-coated after fabrication with not less than 1.2 ounces of zinc per square foot of actual surface, as determined in accordance with tests set forth in ASTM Standard A 90.

2.2 ACCESS CONTROL GATE

A. General....The access control gate, posts, and required fittings and hardware shall conform to the dimensions and material requirements specified in the "General Notes" and details shown on the access control gate drawings.

PART 3 - EXECUTION

3.1 GENERAL

Chain link security fence, chain link gate and access control gate shall be constructed at the locations and alignment shown on the drawings. Chain link security fence and chain link gate shall be the standard commercial product of one manufacturer. Standard commercial products which differ only in nonessential details will be acceptable, subject to the approval of the shop drawings. The finished fence and gates shall conform to alignments and finish grades indicated, with posts plumb and wire and fabric stretched taught.

3.2 INSTALLATION

A. Excavation -

1. Soil Installation.....Excavation for chain link line posts, corner posts, and gate posts shall be carried to 3'-4" below finished grade, and shall be 12" in diameter.

2. Rock Installation.....Excavation for chain link line posts, corner posts, and gate posts shall be carried to a minimum of 3'-0" below finished grade, and shall be of sufficient diameter to allow installation of post with proper grouting-in-place procedures.

3. Access Control Gate Posts.....Excavation for the access control gate posts shall be carried to 3'-6" below finished grade, and shall be 12"

2H-2
in diameter.

The ground surface irregularities along the fence line in areas not being altered by area grading shall be eliminated to the extent necessary to maintain the clearance between the bottom of the fabric and the grade of 2 inches. Post spacing shall be as indicated on the shop drawings but shall not exceed 10'-0".

B. Post Setting.....Posts shall be set in Class C concrete or grout-in-place (rock and structural wall installations) at not less than 3'-0". The concrete or grout shall be thoroughly compacted by the hand-tamp method with a rod of sufficient length to reach the bottom of the post hole, and be finished in a cone top as indicated. Line posts set in structure walls shall conform to the requirements shown on details on the chain link fence drawing. The concrete shall be allowed to cure a minimum of 72 hours before any further work is done on the posts. Care shall be taken to insure proper alignment and plumb installation.

C. Chain Link Fence –

1. Post tops shall be installed as recommended by the manufacturer. The post tops shall be of the design required to accommodate the top rail or to cap the post.

2. Top rail shall be installed prior to installation of chain link fabric. The top rail shall have sleeve couplers a maximum of 21 feet on centers. An expansion contraction coupler standard with the manufacturer shall be provided every 100 feet or fraction thereof. End clamps shall be used for attaching top rail to end posts, gate posts, and pull posts and for attaching brace rails to line posts and end pull and gate posts. Corner clamps shall be used for attaching top rail and braces at corner posts.

3. Fabric shall be attached to the top rail at intervals of not more than 24 inches on centers and to the intermediate posts at intervals of not more than 14 inches on centers with fabric bands or tie wires of 6-gage steel wire. The fabric shall be attached to end, corner, pull, or gate posts with stretcher bars and stretcher bar bands. The bands shall be equally spaced on the stretcher bar and not over 14 inches of centers.

4. Gates shall be of the standard hinged, double drive type, and shall be complete with latches, stops, keepers, roller, fabric braces, and locks, as indicated on the Drawings.

a.Gate frames shall be constructed of 1-1/2 inch nominal diameter galvanized pipe weighing 2.72 lbs. per linear foot. All joints shall be made by welding or by means of heavy screwed fittings. Connections shall be rigid and weathertight. Truss rods shall be 3/8-inch minimum diameter. Intermediate brace members shall be of the same section and weight as the main gate frame members.

b.Gate fabric shall be of the same chain link fabric as is used in the fence. The fabric shall be attached to the gate frame ends by use of bolt hooks, stretcher bar bands, and stretcher bars, or other methods
standard with the manufacturer, except that welding the fabric to the gate frame will not be permitted. The top and bottom of fabric shall be attached with standard wire clips at intervals not exceeding 14 inches on centers.

5. Tension wire shall be galvanized steel wire, No. 9 gauge spiral wire, and shall be secured to all end posts or corner posts with stretcher bar bands.

End of Section
SECTION 2I – ROCK REINFORCEMENT OPEN CUT EXCAVATIONS

PART 1 - GENERAL

1.1 EXTENT OF WORK

The work covered by this Section of the Specifications includes: the drilling of holes for untensioned rock anchors and grouting rock anchors in-place; the drilling of holes for pretensioned rock bolts, tensioning the bolts, and grouting rock bolts in-place; the drilling of holes for untensioned pre-support rock dowels and the grouting of the dowels in-place; the testing of the support installations; and supplying of all the equipment, labor, tools, and the materials for the work. The work shall also include supplying and installing intermediate support; such as steel chain-link fabric to prevent raveling between rock bolts, shotcreting the rock reinforcement systems to prevent corrosion and provide for permanence of the installations, and the remedial treatment of fault zones. The work shall be done in accordance with these Specifications and as shown on the Drawings or as directed by the Owner.

Nothing contained in this Section shall prevent the Contractor from installing at his own expense such amounts of temporary rock reinforcements as he may consider necessary or from using heavier reinforcements than specified. Nothing contained in this section shall be construed to relieve the Contractor from sole responsibility for the safety of the excavations nor for liability for injuries to or deaths of persons or damage to property, nor of any of his obligations under the Contract.

A. Untensioned Rock Anchors for Spillway and Plinth.....Untensioned rock anchors shall be installed in the rock foundation beneath the spillway slab, in the rock behind the crest structure training walls, and in the foundation rock beneath the plinth. The length, diameter and spacing of the rock anchors shall be as shown on the Drawings or directed by the Owner. Drill hole locations, spacings, and inclinations also shall be as shown on the Drawings or directed by the Owner. The rock anchors shall be fully grouted using either resin grout or cement grout.

B. Pretensioned Rock Bolt Reinforcement and Intermediate Support for Permanent Rock Cut at the Outlet Works Intake Structure.....Rock bolt reinforcement and intermediate support shall be installed at the intake structure of the outlet works. The rock reinforcement systems including drill hole inclinations and spacings, bolt length and diameters, chain-link fabric for intermediate support, and shotcrete application are shown on the Drawings. The rock bolts shall be pretensioned and fully grouted using either cement or resin grout.

C. Pretensioned Rock Bolt Reinforcement for the Cascade Spillway.....Rock bolt reinforcement for faces of the cascades are shown on the Drawings. The Drawings indicate the length, spacing, and diameter of the rock bolts; and drill hole inclinations. The rock bolts shall be pretensioned and fully grouted using either cement or resin grout.

D. Untensioned Pre-Support Rock Dowels for Spillway Cascades.....During the excavation of the cascade spillway, untensioned pre-support rock dowels
of reinforcing steel, anchored in drill holes with cement or resin grout shall be installed. The dowels shall be installed prior to the pre-split blasting. The locations, spacings, inclinations, and reinforcing steel diameters are shown on the Drawings.

E. Miscellaneous Applications.....Rock reinforcement in permanent excavations utilizing untensioned rock anchors, pretensioned rock bolts, and untensioned pre-support rock dowels may be required in addition to those shown on the Drawings. Payment for additional miscellaneous rock reinforcement shall be only for the reinforcement required and accepted by the Owner.

F. Remedial Treatment of Fault Zones.....Where required, fault zones encountered in the permanent excavations shall receive remedial treatment as shown on the Drawings. Payment for fault zone remedial treatment shall be made only for the remedial treatment required and accepted by the Owner.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment....All material and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, ANSI, ASTM, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

1.3 SHOP DRAWINGS

Before any products are delivered to the job site, a list of all materials to be furnished under this portion of the work, including material compliance certification, manufacturer's name, catalog number, and catalog cut for each item where applicable shall be submitted to the Owner in accordance with the General Requirements of these Specifications. No payments shall be made for rock reinforcement prior to receiving complete shop drawings.

1.4 PRODUCT HANDLING

A. Protection -

1. All means necessary to protect the materials of this Section before, during and after installation shall be used.

2. Rock anchors, rock bolts, reinforcing bars for dowels, and chain-link fabric shall be stored in a manner to prevent rusting and fouling with dirt, grease, and other bond-breaking coatings.

3. All surfaces of the bearing plates, nuts, flat washers, machine washers, and bevel washers and the threads in the projecting ends of the rock bolts shall be protected and lubricated with plastic grease or mastic of a type approved by the Owner.

4. Resin cartridges shall be stored away from direct sunlight in a dry, cool, and well-ventilated area in accordance with the manufacturer's
recommendations. The manufacturer’s recommended storage life shall not be exceeded.

5. Cement for cement grout shall be stored in weather tight enclosures to protect against dampness and contamination. Admixtures shall be stored properly to prevent contamination, evaporation, freezing, or other damage.

1.5 REPLACEMENTS

----------------------
In the event of damage to rock reinforcement caused by the Contractor’s operations, the Contractor shall immediately make all repairs or replacements necessary to the approval of the Owner and at no additional cost to the Owner. Resin cartridges or other products which show signs of deterioration shall not be used.

1.6 SCHEDULE AND COORDINATION

--------------------------
The Contractor shall schedule and coordinate installation of rock reinforcement with rock excavation for the various areas of work.

PART 2 - PRODUCTS

-------------------------------

2.1 UNTENSIONED ROCK ANCHORS

-------------------
Untensioned rock anchors shall be Grade 60 deformed bars conforming to the requirements of ASTM A-615 and shall be "Dywidag Thread Bar" as manufactured by Dyckerhoff & Widmann, Inc., or Owner approved equal.

Untensioned rock anchors shall be completely fabricated at the point of manufacture under controlled shop conditions and shall be furnished complete with all accessories including couplings, nuts, plates, anchor devices and other materials required.

2.2 CEMENT FOR CEMENT GROUT

-------------------
Cement for cement grout shall be a high early strength expansive type cement similar to WIL-X-Cement manufactured by Williams Form Engineering Corporation or Owner approved equal.

2.3 SAND FOR CEMENT GROUT

-------------------
Sand for cement grout shall conform to the requirements for concrete sand given in Division 3 of these Specifications.

2.4 WATER FOR CEMENT GROUT

-------------------
Water for cement grout shall conform to water requirements for concrete given in Division 3 of these Specifications.

2.5 ADDITIVES FOR CEMENT GROUT

-------------------
Additives for cement grout shall conform to concrete additive requirements given in Division 3 of these Specifications.
2.6 EPOXY RESIN GROUT - SLOW SET

The slow set epoxy resin shall be two-part polyester resin cartridges "Fasloc T" with 15 to 30 minute gel times as manufactured by DuPont Company or Owner approved equal.

2.7 EPOXY RESIN GROUT - QUICK SET

The quick set epoxy resin shall be two-part polyester resin cartridge "Fasloc T" with 1 to 2 minute gel times as manufactured by DuPont Company or Owner approved equal.

2.8 PRETENSIONED RESIN GROUTED ROCK BOLTS

Rock bolts installed with resin grout shall be Grade 60 deformed bars conforming to the requirements of ASTM-615 and shall be "Dywidag Thread Bars" as manufactured by Dyckerhoff and Widmann, Inc., or Owner approved equal.

2.9 PRETENSIONED CEMENT GROUTED ROCK BOLTS

Rock bolts installed with cement grout shall be the hollow groutable Williams-type bolt with mechanical anchors as manufactured by Williams Form Engineering Corporation or Owner approved equal.

2.10 BEARING PLATES

Bearing plates for pretensioned rock bolts shall be 3/8-inch flat steel plates providing not less than 36-square-inch area for each bolt, or as shown on the Drawings.

2.11 WASHERS AND NUTS FOR PRETENSIONED ROCK BOLTS

The bevel washers shall be steel or malleable iron. Machine washers shall be hardened steel. All nuts shall be the manufacturer's heavy hexagonal type.

2.12 CORROSION PREVENTIVE COMPOUND

The threads of the bolts and nuts shall be coated at the factory with a coat of corrosion-preventive compound of a type approved by the Owner.

2.13 LUBRICANT

Lubricant for threads shall be a molybdenum disulfide base such as Molykote "G" as manufactured by the Alph-Molykote Corp., 65 Harvard, Stamford, Conn. or Owner approved equal.

2.14 UNTENSIONED PRE-SUPPORT ROCK DOWELS

Untensioned pre-support rock dowels shall be Grade 60 deformed reinforcing bars conforming to the requirements of ASTM 615.
2.15 CHAIN-LINK FABRIC

The chain-link fabric shall conform to AASHTO Specification M181 Type 1 Class A, No. 6 (0.1920-inch) steel wire gauge woven into a 2-inch diamond mesh.

2.16 SHOTCRETE

Shotcrete to be applied over rock bolts and chain-link fabric to protect the metallic elements from corrosion shall conform with Division 3 of these Specifications.

PART 3 - EXECUTION

3.1 UNTENSIONED ROCK ANCHORS

A. General.....The work for this Section of the Specifications includes the drilling of holes and supplying, installing and grouting of steel rock anchors into the rock at the spillway slab, spillway crest structure training walls, dam plinth, and other areas as shown on the Drawings and specified herein. The Owner may direct that the number, location, length and/or inclination of the anchors be varied depending on foundation conditions encountered. If longer bars are needed it shall be permissible to use couplings specified by the anchor bar manufacturer.

B. Drilling of Holes.....The anchor bar holes shall be drilled using either percussion or rotary drilling methods. If cement grout is used the diameter of the holes shall not be less than 1.5 times the diameter of the anchor specified for that hole, or if epoxy-type resin grout is used, the hole diameter shall correspond to that specified by the resin manufacturer for the bar diameter and the resin cartridges to be used.

C. Preparation of Holes.....Immediately prior to anchor installation, the rock anchor hole shall be blown clean with compressed air until no water or debris remains in the hole. If the rock anchor is not to be grouted in-place immediately, the hole shall be tightly plugged and again cleaned immediately prior to the installation of rock anchors.

D. Installation of Rock Anchors.....If cement grout is used, the hole shall be partially filled with grout and the rock anchor forced into place while vibrated with a concrete vibrator, after which any remaining void near the top of the hole shall be filled with grout. If a concrete vibrator is not used to insert the rock anchors, a tremie pipe shall be used to fill the hole from the bottom. Holes into which water is seeping or running shall be grouted upward from the bottom by means of a tremie pipe to prevent the dilution of grout before insertion of the bar. Cement grout mix for rock anchors shall be a thick sand-cement grout having a water-cement ratio of less than 0.6:1 by weight and a sand-cement ratio of 3:1 by weight. Cement grout compressive strengths shall equal or exceed the following:

- 1 Day - 2100 psi
- 2 Days - 4200 psi
- 3 Days - 5100 psi
The Contractor shall prepare trial grout mixes and provide core or cylinder samples for compressive strength testing by the Owner who will determine conformance with the required compressive strengths. The grout mix to be used for anchor bar installation shall be subject to approval of the Owner.

The rock anchors shall be positioned at the center of the hole by the use of suitable non-metallic spacers. The entire grouting procedure shall be approved by the Owner. Grouting of rock anchors shall be done not less than 2 days in advance of their embedment in concrete. Any rock anchors which are found to be loose after the grout has hardened shall be reset at no additional cost to the Owner. Such regrouting of rock anchors shall also be done not less than 2 days in advance of their embedment in concrete.

If resin grout is used, slow set resin cartridges shall be inserted into the hole prior to rock anchor installation. The rock anchors shall be pushed into the cartridges and rotated to mix the epoxy with the hardener in accordance with the manufacturer’s specifications. Installation of resin grouted bars shall be complete at least 60 minutes prior to their embedment in concrete.

A sufficient number of resin cartridges or volume of cement grout shall be placed in each hole to ensure that the hole is completely filled with grout after the rock anchor is advanced to the bottom of the hole. Holes not completely filled with grout shall be considered unacceptable, and the Contractor shall drill and install a replacement rock anchor, acceptable to the Owner, as close as practical to the unacceptable anchor, at the Contractor’s expense.

E. Rock Anchor Capacity Testing.....After rock anchor installation, the grout shall have a minimum set time of 60 minutes prior to testing if resin grout is used, unless otherwise specified by the resin manufacturer. If cement grout is used, the grout shall have a minimum set time of 2 days prior to testing.

At periodic intervals of one test per 20 anchors, #8 rock anchors shall be tension tested with a hydraulic jack to develop a pull strength of 46,000 pounds, and #10 rock anchors shall be tension tested with a hydraulic jack to develop a pull strength of 58,000 pounds. All performance tests shall be conducted in the presence of the Owner. If the rock anchor or grout fails at this load, the rock anchor shall be considered unacceptable, the Contractor shall install a replacement rock anchor, acceptable to the Owner, as close as practical to the unacceptable rock anchor, at the Contractor’s expense.

The Contractor shall provide and maintain in good working condition, the necessary jacks, certified calibrated pressure gauges and related equipment, and labor as approved by the Owner, necessary for performing tension tests on the rock anchors.

3.2 PRETENSIONED ROCK BOLTS

A. General.....The work for this Section of the Specifications includes the drilling of holes and supplying, installing, grouting, and pretensioning
of rock bolts for reinforcing the rock cuts above the intake structure, reinforcing the rock in the riser faces of the spillway, and other areas as shown on the Drawings. Miscellaneous rock bolts for rock reinforcement, in addition to those shown on the Drawings, may be required in the permanent rock excavations. Payment for miscellaneous rock bolts shall be only for bolts required and accepted by the Owner.

B. Drilling of the Holes.....The holes for the rock bolts shall be drilled to the inclinations and depths shown on the Drawings or as directed by the Owner. If mechanical anchor bolts are used, the hole diameters shall be appropriate for the bolt diameters in accordance with the manufacturer's Specifications. If resin grouted bolts are used, the holes shall be drilled to the resin manufacturer's specified diameter for the applicable bolt and resin cartridge diameters. The holes shall be drilled using either percussion equipment or rotary drilling equipment.

C. Preparation of Holes.....Immediately prior to inserting the rock bolts, the holes shall be blown clean with compressed air until no water or debris remains in the holes. If the rock bolt is not to be grouted in-place immediately, the hole shall be tightly plugged and again cleaned immediately prior to installing the bolts.

D. Cement Grouted Rock Bolts.....Cement grouted rock bolts shall be inserted into the completed drill holes, bearing plates and machine washers attached, and the anchors expanded and seated by tightening the hex nut on the protruding threads. Before inserting the bolts, the bolts and other parts should be examined for damage which could be detrimental to the strength of the rock bolts. The specified torque applied shall pretension the bolts to approximately two-thirds of the bolt working capacity. After initial installation, the Contractor shall ensure the rock bolts continue to act as effective reinforcement by periodically testing the rock bolts with a calibrated torque wrench, and if necessary, retightening to the specified torque or tension.

The Contractor shall supply all accessories for grouting rock bolts in-place after installation. The grouting shall be conducted as soon as practical after installation, but in any event within 21 days of installation. The grout shall be a water/cement grout with a 0.4:1 water/cement ratio by weight. The grout shall be forced into the drill holes through the hollow bolts to fill completely the annular space between the rock and the rock bolts up to and including the anchors of the bolts. If during the grouting, grout is found to flow from points of the rock surface adjacent to the bolts, such leaks shall be plugged and caulked by the Contractor to the approval of the Owner, and at no additional cost to the Owner.

E. Resin Grouted Rock Bolts.....Quick-set resin cartridges shall be inserted in the holes to approximately 30% of the bolt lengths, but not less than 24 inches. The remainder of the bolt holes shall be filled with slow-set resin. The installation of the bolts through the resin cartridges to mix the resin and hardener shall be in accordance with the manufacturer's Specifications. Resin grouted bolts shall be torque tightened to approximately two-thirds of working capacity as soon as the quick-set resin in the end of the holes has set, but before the slow-set
resin in the remaining section of the holes has set.

F. Rock Bolt Capacity Testing.....Five out of every 100 bolts installed shall be tested, by direct tension to 46,000 pounds, to verify the anchorage capacity and the installation techniques. For resin grouted bolts, the resin shall have a minimum set time of 60 minutes prior to testing, unless otherwise specified by the resin manufacturer. For cement grouted bolts, the cement shall have a minimum set time of 2 days. All performance tests shall be conducted in the presence of the Owner. If the rock bolt or grout fails at this load, the rock bolt shall be considered unacceptable, and the Contractor shall install a replacement rock bolt, acceptable to the Owner, as close as practical to the unacceptable bolt, at the Contractor's expense.

The Contractor shall provide and maintain in good working condition, the necessary jacks, certified calibrated pressure gauges and related equipment, and labor, as approved by the Owner, necessary for performing tension tests on the rock bolts.

3.3 UNTENSIONED PRE-SUPPORT DOWELS
-------------------------------------------------
A. General.....The work of this Section of the Specifications includes the drilling of holes and supplying, installing, and grouting of untensioned, pre-support rock dowels near the edges of the benches in the spillway as shown on the Drawings and specified herein. The Owner may direct that the number, location, length and/or inclination of the dowels be varied depending on the rock conditions encountered. The dowels shall be installed at least two days prior to the pre-split blasting for the cascade face at the edge of the bench if cement grout is used for the dowels. If resin grout is used, the resin shall be allowed to fully set prior to pre-split blasting in accordance with the resin manufacturer's specifications. Miscellaneous pre-support dowels for rock reinforcement, in addition to those shown on the Drawings, may be required in the permanent rock excavations. Payment for miscellaneous pre-support rock dowels shall be only for dowels required and accepted by the Owner.

B. Drilling of Holes.....The diameter of the drill holes for the rock dowels shall not be less than 1.5 times the diameter of the reinforcing steel dowel specified for that hole if cement grout is used, or if resin grout is used, the hole diameter shall be in accordance with the resin manufacturer's Specifications for the bar and resin cartridge diameters to be used. The holes shall be drilled at the inclinations and to the depths shown on the Drawings or as directed by the Owner. The holes shall be drilled using either percussion or rotary drilling techniques.

C. Preparation of Holes.....Immediately prior to dowel installation, the rock dowel holes shall be blown clean with compressed air to remove drill cuttings, water, or debris from the hole. If the dowels are not to be grouted in-place immediately, the hole shall be capped and plugged and again cleaned immediately prior to the placing of dowels.

D. Installation of Dowels.....For installation of the rock dowels, the holes shall be partially filled with cement grout and the anchor bar forced into place while vibrated by a concrete vibrating machine, after
which any remaining voids shall be filled with grout. Holes into which
water is seeping or running shall be grouted upward from the bottom by
means of a tremie pipe to prevent the dilution of grout before insertion
of the dowel. The dowels shall be positioned in the center of the hole
by the use of suitable non-metallic spacers. Grouting of the dowels
shall be done not less than two days in advance of the pre-split
blasting if cement grout is to be used. Any dowels which are found to
be loose after the grout has hardened shall be reset at no additional
cost to the Owner. Cement grout mix for pre-support dowels shall be a
thick sand cement grout having a water-cement ratio of less than 0.6:1
by weight and a sand-cement ratio of 3:1 by weight. Cement grout
compressive strengths shall equal or exceed the following:

1 Day - 2100 psi
2 Days - 4200 psi
3 days - 5100 psi

The Contractor shall prepare trial grout mixes and provide core or
cylinder samples for compressive strength testing by the Owner who will
determine conformance with the required compressive strengths. The
grout mix to be used for anchor bar installation shall be subject to the
approval of the Owner.

If epoxy resin is used for grouting the dowels, installation of the
dowels shall be in accordance with the manufacturer's Specifications.
Because of the relatively quick set time for the epoxy resin, blasting
can take place as soon as the resin grout achieves its set in accordance
with the manufacturer's specifications.

3.4 CHAIN-LINK FABRIC
------------------
A. Installation.....Wherever chain-link fabric intermediate support is
indicated on the Drawings or directed by the Owner, the rock bolts shall
be installed through the chain-link fabric. The bearing plates for the
rock bolts shall be placed on the outside of the chain-link fabric and
the bolts pretensioned in accordance with Section 3.2 of this Section,
thus tightening the chain-link fabric against the rock surface. The
width of the chain-link fabric shall be coordinated with the rock bolt
installation pattern. The fabric shall be lapped at the rock bolts a
minimum of three mesh openings. The chain-link fabric shall not be
lapped at intermediate points between bolts. Miscellaneous applications
of chain-link fabric, other than those shown on the Drawings, may be
required in the permanent rock excavations. Payment shall be made only
for the additional applications of chain-link fabric that are required
and accepted by the Owner.

3.5 SHOTCRETE
--------
A. Application.....Shotcrete shall be applied as indicated on the Drawings
or when required and approved by the Owner in preliminary excavations.
The shotcrete shall be placed using a delivery system and procedures
approved by the Owner and in accordance with Division 3 of these
Specifications. For the protection of permanent rock excavations and
reinforcement, the shotcrete layer shall be at least 3 inches in
thickness as shown on the Drawings. Miscellaneous applications of
shotcrete, other than those shown on the Drawings, may be required in the permanent rock excavations. Payment shall be made only for the additional shotcrete applications that are required and accepted by the Owner.

Following the seven day initial cure period, at locations shown on the Drawings or when required and accepted by the Owner, the Contractor shall drill weep holes through the shotcrete surface to provide for drainage of the rock behind the shotcrete. The weep holes shall be drilled in a 5-foot by 5-foot grid pattern and shall be at least 1 inch in diameter but not more than 2 inches in diameter. The weep holes shall penetrate at least 1 inch into the rock behind the shotcrete layer.

3.6 REMEDIAL TREATMENT OF FAULT ZONES

Remedial treatment of fault zones encountered in permanent rock excavations using shotcrete applications may be required. Remedial fault treatment shall be in accordance with the Drawings. Payment for remedial fault treatment shall be made only for treatment required and accepted by the Owner.

End of Section
SECTION 2J - TUNNEL AND SHAFT EXCAVATION AND SUPPORT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

The work covered by this Specification includes supplying all labor, equipment and materials; and performing all operations in connection with excavating, supporting, draining, lighting, ventilating and maintaining the tunnels and shafts in a suitable condition until the concrete and steel linings have been constructed in the outlet works to the satisfaction of the Owner and until the stream diversion through the diversion tunnel is no longer required.

1.2 EXTENT OF WORK

A. Excavating, supporting and maintaining the unlined diversion tunnel sections between Stations 0+00 and 5+17.46 and between Station 12+75.45 and 20+34.21 during the period that the stream is diverted through the tunnel, and during construction.

B. Excavating, supporting, and maintaining the outlet works tunnel between Stations 0+00 and 10+06.85 until the concrete and steel linings have been constructed.

C. Excavating, supporting, and maintaining the shaft between elevation 6496 and Elevation 6456 through the transition to the tunnel, at Station 0+00 until the concrete lining has been constructed.

The tunnel shall be constructed in accordance with the applicable sections of these Specifications.

Structural steel ribs shall be used to support the roof and sides of the temporary diversion tunnel, the outlet works tunnel, and the outlet works shaft as shown on the Drawings. Additional tunnel supports may be installed to support the roof and sides of the tunnel and shaft where conditions encountered are such as to require additional support. The type and amount of additional supports (structural steel ribs, rock bolts with or without chain-link fabric, or shotcrete) at any location shall be subject to the approval of the Owner.

Nothing contained in these Specifications shall prevent the Contractor, at his own expense, from erecting such amounts of additional temporary supports as he may consider necessary, or from using more rock-support bolts or heavier structural steel supports than approved by the Owner, if use of such additional rock bolts or heavier steel ribs results in no increased cost to the Owner, including the cost of additional excavation. Nothing in these Specifications shall be construed to relieve the Contractor from sole responsibility for the safety of the tunnels and shaft, or from liability or injuries to or deaths of persons or damaged property.

1.3 QUALITY ASSURANCE

Tunnel and shaft excavations shall be made to the lines, grades, and
dimensions shown on the Drawings or as established by the Owner. Surveying of the excavations, provided by the Owner, shall be used to determine the conformance of the excavations with the Drawings and Specifications.

Structural steel rib support shall be installed as shown on the Drawings to the proper lines and grades and shall be maintained by the Contractor in the proper conditions and alignment until diversion is no longer required through the temporary diversion tunnel, and the concrete lining is placed around the steel ribs in the outlet works tunnel and shaft. The installation of the steel rib support, rock bolts, chain-link fabric, and shotcrete shall be inspected by the Owner for conformance with the Drawings and Specifications.

All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, ANSI, ASTM, etc. The work of this section shall be performed by journeymen, well-versed in the trades involved.

1.4 MATERIALS TO BE EXCAVATED

The materials to be excavated for the tunnels and shaft will be mainly rock. The rock at the Deer Creek Dam site to be excavated for the temporary diversion tunnel, outlet works tunnel, and outlet works shaft consists of complexly intermixed granite, granite (felsic) gneiss, mafic and felsic intrusive rock, which are usually hard, dense, and strong. Fault breccias, shear zones, and areas of altered rock are also present and will probably be encountered in the underground excavations. The fault breccias and shear zones have the consistency of soil and contain clay minerals. The altered rock ranges from hard, dense and strong, to soft and weak. The rock is complexly fractured and jointed. Logs of the geotechnical exploratory holes are in Appendix A of these Specifications. The exploratory holes encountered groundwater levels above the proposed tunnels and shaft.

1.5 HANDLING OF EXCAVATED MATERIALS

Excavated materials suitable for construction shall be stockpiled and utilized in accordance with Section 2C of these Specifications. Excavated materials unsuitable for use in the construction shall be wasted in accordance with both Sections 2C and 2G of these Specifications.

1.6 DESIGN LINES

Design lines are excavation lines within which no intrusion from rock, lagging, etc., shall be permitted to remain. The Design lines are shown on the Drawings. The Contractor shall determine the amount of excavation outside the Design line that is necessary to allow installation of tunnel and shaft supports.
1.7 SHOP DRAWINGS

Before any products are delivered to the job site, the Contractor shall submit to the Owner in accordance with the General Requirements of these Specifications, a list of all materials to be furnished under this portion of the work, including material compliance certification, manufacturers name, catalog cut for each item where applicable. Copies of the manufacturers installation instructions shall be submitted to the Owner for his use at the job site. Payment shall not be made for work described in this section until shop drawings are complete.

1.8 PRODUCT HANDLING

All means necessary to protect the materials before, during and after installation shall be used.

The steel ribs and accessories shall be stored in a manner to prevent unnecessary fouling with dirt, rust, grease and other bond breaking coatings.

Rock bolts and chain link fabric shall be stored in a manner to prevent rusting and fouling with dirt, grease, and other bond breaking coatings. All surfaces of the bearing plates, nuts, flat washers, machine washers, and bevel washers and the threads in the projecting ends of the rock bolts shall be protected and lubricated with plastic grease or mastic. Resin cartridges shall be stored away from direct sunlight in dry, cool, and well-ventilated areas in accordance with the manufacturer's recommendations. The manufacturer's recommended storage life shall not be exceeded. Cement for cement grout shall be stored in weather tight enclosures to protect against dampness and contamination. Admixtures shall be stored properly to prevent contamination, evaporation, freezing, or other damage.

Products for shotcrete shall be handled in accordance with Division 3.

1.9 REPLACEMENT

In the event of damage to tunnel or shaft supports, the Contractor shall immediately make all repairs or replacements necessary to the approval of the Owner and at no additional cost to the Owner. Resin cartridges or other products which show signs of deterioration shall not be used and shall not be paid for.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL RIB SUPPORTS

The steel ribs shall be W6x25 ribs fabricated of normal grade steel conforming to ASTM Specification A-36 having a minimum yield strength of 36,000 psi or Owner approved equal.

2.2 FOOT BLOCKS, LAGGING, BLOCKING, AND TIE RODS

Material used for foot blocks, wedges, and blocking shall be timber, steel, or precast concrete. All timber shall be well seasoned, sound
oak or other approved hardwood of rectangular section. All lagging in the outlet works tunnel and shaft to be lined with concrete shall be of steel or approved precast concrete. Lagging for the diversion tunnel that will remain unlined shall be steel, approved precast concrete, or timber. All tie rods, butt plates and lagging clamps shall be steel as shown on the Drawings.

2.3 RESIN GROUTED ROCK BOLTS

Rock bolts to be installed with resin grout shall be 1-inch diameter Grade 60 deformed bars conforming to the requirements of ASTM A-615 and shall be "Dywidag Thread Bar" as manufactured by Dyckerhoff & Widmann, Inc., or Owner approved equal.

2.4 CEMENT GROUTED ROCK BOLTS

Rock bolts installed with cement grout shall be the 1-inch diameter hollow groutable Williams-type bolts with mechanical anchors as manufactured by Williams Form Engineering Corporation or Owner approved equal.

2.5 EPOXY RESIN GROUT - SLOW SET

The slow set epoxy resin shall be two-part polyester resin cartridges "Fasloc T" with 15 to 30 minute gel times as manufactured by DuPont Company or Owner approved equal.

2.6 EPOXY RESIN GROUT - QUICK SET

The quick set epoxy resin shall be two-part polyester resin cartridge "Fasloc T" with 1 to 2 minute gel times as manufactured by DuPont Company or Owner approved equal.

2.7 CEMENT GROUT FOR ROCK BOLTS

Cement grout shall be a water/cement grout with a water/cement ratio by weight of 0.4:1, made using high early strength expansive type cement similar to WIL-X-Cement manufactured by Williams Form Engineering Corporation or Owner approved equal.

2.8 BEARING PLATES

The bearing plates shall be 3/8-inch flat steel plates providing not less than 36-square-inch area for each bolt, as shown on the Drawings or, if approved by the Owner, a length of structural steel channel or other structural shape may be used.

2.9 WASHERS AND NUTS

The bevel washers shall be steel or malleable iron. Machine washers shall be hardened steel. All nuts shall be the manufacturer’s heavy hexagonal type.
2.10 CORROSION PREVENTION COMPOUND

The threads of the bolts and nuts shall be coated at the factory with a coat of corrosion-preventive compound of a type approved by the Owner.

2.11 LUBRICANT

Lubricant for threads shall be a molydenum disulfide base such as Molykote "G" as manufactured by the Alph-Molykote Corp., 65 Harvard Avenue, Stamford, Conn., or Owner approved equal.

2.12 CHAIN-LINK FABRIC

The chain-link fabric shall conform to AASHTO Specification M181 Type 1 Class A, No. 6 (0.1920-inch) steel wire gauge woven into a 2-inch diamond mesh.

2.13 SHOTCRETE

Shotcrete for tunnel applications shall be in accordance with Division 3.

PART 3 - EXECUTION

3.1 DRAINAGE, LIGHTING, AND VENTILATION

A. General.....The Contractor shall drain the tunnels and shaft of water by gravity flow or pumping as necessary to obtain satisfactory working conditions and to keep the tunnel in a serviceable condition until the lining or diversion is complete. If substantial flows of water are encountered, the Contractor shall seal off water entering the tunnels and shaft in order to decrease the amount of water to be pumped or drained. The Contractor shall adequately light and ventilate the tunnel during all construction operations. The Contractor shall provide all labor and materials necessary to obtain satisfactory working conditions.

3.2 TUNNEL AND SHAFT EXCAVATION

A. General.....The tunnels and shaft shall be excavated to the lines, grades, and dimensions shown on the Drawings or established by the Owner. The Contractor shall determine the amount of excavation outside the Design lines that is necessary to allow installation of tunnel and shaft supports.

The Contractor shall use drilling and blasting techniques which shall produce a smooth final profile, a minimum of overbreak, and a minimum of stressing or fracturing of the rock beyond the Design lines, and cause a minimum of fallout. Steel rib supports and steel and timber lagging shall be firmly packed against the rock surfaces. Any damage to or displacement of supports, and any damage to any part of the works caused by blasting or any other operations by the Contractor shall be repaired at the expense of the Contractor and in a manner satisfactory to the Owner.

Immediately following blasting during mucking and clean up, all loose
material that is likely to fall, shall be removed. All material projecting inside the Design lines shall be removed by the Contractor as part of the work described in this Section. Loose excavation materials at the base of the sidewalls and on the invert shall be removed to clean undisturbed surfaces.

3.3 PERMANENT STRUCTURAL STEEL RIB SUPPORTS, CONCRETE LINED OUTLET WORKS TUNNEL AND SHAFT

A. General.....Structural steel ribs shall be used to support the roof and sides of the outlet works tunnel and shaft as shown on the Drawings.

B. Installation.....The structural steel ribs shall be installed to the proper lines, grades, and spacings shown on the Drawings, and maintained by the Contractor in proper condition and alignment until the concrete lining is placed around them. Improper installation of structural steel ribs shall be corrected by the Contractor within 48 hours after the improperly installed supports are called to his attention, and at no additional cost to the Owner. The structural steel ribs shall be installed as soon after blasting as practical and as close to the working face as practical.

C. Foot Blocks, Lagging, Blocking, Wedges and Tie Rods.....The dimensions and amounts of foot blocks, blocking, and tie rods are shown on the Drawings. The dimensions and amount of lagging and wedges are not shown on the Drawings, but in all cases shall be installed as necessary to serve their functions and for safety. Lagging shall be steel or approved pre-cast concrete. No timber lagging shall be used in the outlet works tunnel and shaft.

Lagging and blocking shall be placed in the form of open cribbing and shall be arranged to permit the ready flow of concrete through and around the lagging and blocking so that the concrete lining when placed shall be in contact with at least one-half of the excavated surface area bounded by the centerline of adjacent steel supports, and so that at least one-half of the distance between structural steel rib supports shall be free of blocking and steel lagging.

3.4 PERMANENT STRUCTURAL STEEL RIB SUPPORTS, UNLINED DIVERSION TUNNEL

A. General.....Structural steel ribs shall be used to support the roof and sides of the diversion tunnel as shown on the Drawings.

B. Installation.....The structural steel ribs shall be installed to the proper lines, grades, and spacings shown on the Drawings, and maintained by the Contractor in proper condition and alignment until the tunnel plugs are complete and stream diversion is no longer required. Improper installations of structural steel ribs shall be corrected by the Contractor within 48 hours after the improperly installed supports are called to his attention, and at no additional cost to the Owner. The structural steel ribs shall be installed as soon after blasting as practical and as close to the working face as practical.

C. Foot Blocks, Lagging, Blocking, Wedges and Tie Rods.....The dimensions and amounts of foot blocks, blocking, and tie rods are shown on the
3.5 ADDITIONAL TUNNEL AND SHAFT SUPPORTS

A. General——Additional tunnel and shaft support in excess of those shown on the Drawings may be required to temporarily support the tunnel and shaft. Additional tunnel and shaft supports may include: structural steel ribs, rock bolts, chain-link fabric for intermediate support between steel ribs or rock bolts, and shotcrete. The type and amounts of additional support if required shall be subject to the acceptance of the Owner. Refer to Section 1.2 of these Tunnel and Shaft Excavation and Support Specifications.

B. Structural Steel Rib Supports —

1. General——Additional structural steel ribs if required and approved by the Owner shall be used to support the roof and sides of the outlet works tunnels and shaft. Payment for additional steel ribs shall be made only for the additional steel ribs required and accepted by the Owner.

2. Installation——Additional structural steel ribs shall be installed to the proper lines, grades, and maintained by the Contractor in proper condition and alignment in the outlet works tunnel and shaft until concrete is placed around them. In the diversion tunnel the structural steel ribs shall be maintained in proper condition and alignment until the tunnel plugs are complete and stream diversion is no longer required. Improper installation of additional structural steel ribs shall be corrected by the Contractor within 48 hours after the improperly installed supports are called to his attention, and at no additional cost to the Owner. The structural steel ribs shall be installed as soon after blasting as practical and as close to the working face as practical.

3. Foot Blocks, Lagging, Blocking, Wedges and Tie Rods——The dimensions and amounts of foot blocks, blocking, and tie rods are shown on the Drawings. The dimensions and amount of lagging and wedges are not shown on the Drawings, but in all cases shall be installed as necessary to serve their functions and for safety.

In the outlet works tunnel and shaft, steel lagging or approved precast concrete lagging shall be required and lagging and blocking shall be placed in the form of open cribbing and shall be arranged to permit the ready flow of concrete through and around the lagging and blocking so that the concrete lining when placed will be in contact with at least one-half of the excavated surface area bounded by the centerlines of adjacent steel supports, and so that at least one-half of the distance between structural steel rib supports will be free of blocking and steel lagging.

In the diversion tunnel, lagging shall be steel, approved precast concrete, or timber. Lagging and blocking shall be placed as necessary to serve the function of temporary support and safety.
C. Rock Bolt Support -

1. General.....Rock bolts shall be used at the locations as shown on the Drawings and may be used for additional support for the roof and sides of the tunnel and shaft as approved by the Owner. Payment for additional rock bolts not shown on the Drawings shall be only for the rock bolts required and accepted by the Owner.

Where rock bolts are used to support the roof and sides of the tunnels and shaft they shall be of either cement grouted expansion anchor type or resin grouted bolts as specified in this section and as approved by the Owner.

The rock bolts shall be furnished complete with all accessories including bearing plates, anchor devices, bevel washers, machine washers, nuts, rust-preventive compound, lubricant, cement grout, resin grout, and other materials required for installation of the rock bolts. The minimum length of bolts shall be 8 feet.

Rock bolt installations shall follow the advancement of the heading. The bolts or bolting pattern shall be advanced to approximately 5 feet from the face following each blasting operation. Such installation shall be completed within 6 hours following blasting to prevent loosening of the rock.

2. Drilling of the Holes.....The holes for the rock bolts shall be drilled to depths appropriate for the length of bolts to be installed and at inclinations perpendicular to the rock surface. The hole diameters shall be appropriate for the bolt diameters in accordance with the manufacturer’s recommendations, if mechanical anchor bolts are used. If resin grouted bolts are used, the holes shall be drilled to the resin manufacturer’s recommended diameter for the applicable bolt and resin cartridge diameters. The holes may be drilled using either percussion equipment or rotary drilling equipment.

3. Preparation of Holes.....Immediately prior to inserting the rock bolt in the hole, the hole shall be blown clean with compressed air until no water or debris remains in the hole. If the rock bolt is not to be grouted in-place immediately, the hole shall be tightly plugged and again cleaned immediately prior to the placing of the bolts.

4. Installation of Mechanical Anchor Cement Grouted Bolts.....If bolts with mechanical anchors and cement grout are used, the bolts shall be inserted into the completed drill holes, bearing plates and machine washers attached, and the anchors expanded and seated by tightening the hex nut on the protruding threads. Before inserting the bolts, the bolts and other parts should be examined for damage which could be detrimental to the strength of the rock bolts. Preliminary torque applied shall tension the bolts to two-thirds of the bolts working capacity. After initial installation, the Contractor shall ensure the rock bolts continue to act as effective reinforcement by periodically testing the rock bolts with a calibrated torque wrench, and if necessary, retightening to the directed torque or tension.

The Contractor shall supply all accessories for grouting rock bolts
in-place after installation. The grouting should be conducted as soon as practical after installation, but in any event within 21 days of installation. The grout shall be forced into the drill holes to fill completely the annular space between the rock and the rock bolts up to and including the anchors of the bolts. If during the grouting, grout is found to flow from points of the rock surface adjacent to the bolts, such leaks shall be plugged and caulked by the Contractor to the approval of the Owner and at no additional cost to the Owner. The grout shall be a cement/water grout as specified in this section.

5. Installation of Resin Grouted Rock Bolts.....If resin grout bolts are used, quick-set resin cartridges shall be inserted in the holes to approximate 30% of the bolt lengths, but not less than 24 inches. The remainder of the bolt holes shall be filled with slow-set resin. The installation of the bolts through the resin cartridges shall be in accordance with the manufacturer's specifications. The bolts shall be torque tightened to approximately two-thirds of working capacity as soon as the quick-set resin in the end of the holes has set, but before the slow-set resin in the remaining section of the holes has set.

6. Replacements.....At periodic intervals, as determined by the Owner, the Contractor shall check and where necessary retighten all rock bolts to the required torque or bolt tension until completion of the work under these Specifications. If a bolt 5 feet or more from the heading has been damaged or made ineffective by blasting operations, the damage shall be repaired and, if necessary, additional bolts shall be installed to replace the damaged or ineffective bolts, all at the expense of the Contractor. If installation of rock bolts closer than 5 feet from the heading is approved by the Owner and such bolts are damaged during blasting operation, repair of the damaged bolts and for any additional bolts required to be installed to replace the damaged or ineffective bolts shall be paid for by the Owner.

D. Chain-Link Fabric –

1. General.....Chain-link fabric shall be used at the locations as shown on the Drawings, and shall be used at additional locations to provide intermediate support and prevent rockfall between rock bolts or steel ribs as directed by the Owner. Payment for additional chain-link fabric not shown on the Drawings shall be made only for chain-link fabric required and accepted by the Owner

2. Installation.....Chain-link fabric shall be installed with rock bolts, the fabric shall be placed at the time rock bolts are installed. The fabric shall be placed between the rock surface and the rock bolt bearing plates. The Contractor shall lap sections of fabric a minimum of 6 inches or three mesh openings where practicable; provided, that at connections where it is impracticable to maintain 6-inch laps, as determined by the Owner, the Contractor will be permitted to extend laps in lieu of cutting along regular lines. The final layout of the fabric and extent of lapping shall be subject to approval of the Owner.

Where required and approved by the Owner, rock bolts shall be installed at intermediate points for fastening the chain-link fabric to the rock. The intermediate rock bolts shall be installed in such manner that the
chain-link fabric is held securely between the rock surface and the bearing plate.

E. Shotcrete -

1. General....Shotcrete shall be applied at the locations as shown on the Drawings, and shall be used at additional locations to provide a protective or structural coating of shotcrete on finished excavated surfaces in the tunnel and shaft as directed by the Owner. The protective or structural coating shall be applied to portions of the surfaces which are subject to deterioration by air slaking and fallout. The final excavated surfaces shall be protected within 1 hour after exposure. Payment for additional shotcrete applications not shown on the Drawings shall be made only for shotcrete required and accepted by the Owner.

2. Surface Preparation.....Surfaces to be coated shall be cleaned of all loose material, dirt, dust, mud, and other foreign matter. Temporary protective coverings applied at the Contractor's expense and approved by the Owner, shall be permitted, if necessary, until the permanent protective or structural shotcrete coating is applied. Shotcrete damaged by frost, heat or other causes shall be removed and replaced or repaired at the expense of the Contractor as directed.

3. Application.....Shotcrete mix to be applied shall conform to Division 3. Shotcrete mixing and application equipment shall at all times be subject to the approval of the Owner. The shotcrete shall be applied in layers not less than 1-inch in thickness. Precautions shall be taken to minimize the accumulation of rebound.

4. Curing.....Curing of applied shotcrete shall be provided to prevent the development of cracking due to rapid loss of moisture following application. The curing shall be sufficient to assure adequate hydration of the cement.

F. Remedial Treatment at Fault Zone.....Fault zones encountered in the outlet works tunnel may require remedial treatment. Where required and approved by the Owner, fault zones shall be treated with shotcrete in accordance with the Drawings. Payment for remedial treatment of fault zones shall be made only for remedial treatment required and accepted by the Owner.

G. Preparation for Placing Concrete Lining -

1. General.....The Contractor shall prepare the permanent outlet works tunnel and shaft for placement of concrete in accordance with the requirements of this Section.

Where appreciable quantities of water flows are encountered from the rock surrounding the tunnel, the water shall be excluded from the space to be filled with concrete by grouting; by caulking; by diverting with pipe, pans or other means; or by pumping from sumps until the concrete has hardened and gained sufficient strength to be unaffected by the action of water through percolation, hydrostatic pressure, or erosion.
All material projecting from inside the design line shall be removed by the Contractor before concrete is placed.

Loose excavation at the base of the side walls and on the invert shall be removed by cleaning to undisturbed surfaces before the concrete is placed.

Timber blocking and timber wedges shall be removed as completely as practical before the concrete is placed.

H. Drilling of Feeler and Pilot Holes ahead of Underground Excavation -

1. General.....When directed by the Owner, feeler or pilot holes shall be drilled with percussion type drills ahead of underground excavations to determine in advance the nature of the materials to be excavated or the existence of water-bearing seams or strata or for the purpose of grouting. The minimum length of feeler or pilot holes shall be 15 feet with a maximum length of 40 feet. The diameter of each hole shall be not less than 1.5 inches. The location, direction, length and number of holes shall be as directed by the Owner. When feeler or pilot holes are required in the tunnel and shaft excavations, other operations shall be suspended or modified as may be necessary to permit such drilling and grouting and the Contractor shall not be entitled to any additional compensation or extension of time on account of such requirements.

Nothing contained in this Section of these Specifications shall prevent the Contractor at his own expense from drilling feeler or pilot holes ahead of the underground excavation as he may consider necessary.

End of Section
SECTION 2K - EMERGENCY ACCESS TRAIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section shall consist of providing all labor, material, and equipment required for the construction of the Emergency Access Trail as shown on the Drawings.

B. This section is closely related to the following work that is described elsewhere in these Specifications:

1. Excavation-Open Cut - Section 2C.
2. Aggregates for Access Roads, Parking Lots, Boat Ramp, and Gaging Stations - Section 2Q
3. Revegetation of Dam Area - Section 2GG.

PART 2 - PRODUCTS

Crushed Aggregate Surface Course shall meet the requirements of Section 2Q of these Specifications.

PART 3 - EXECUTION

3.1 GENERAL

This work shall be performed prior to the work required in Section 2GG of the Specifications. The alignment of the work shall be as shown on the Drawings or as directed by the Owner. The work shall be constructed to a grade of 15% or as directed by the Owner. The Contractor shall be permitted to use portions of his haul road for the work as approved by the Owner.

A. Excavation....The work shall be excavated as shown on the Drawings or as directed by the Owner in accordance with Section 2C of the Specifications.

B. Crushed Aggregate Surface Course.....Crushed Aggregate Surface Course shall be placed to the depth and width shown on the Drawings. The Crushed Aggregate Surface Course shall be wheel compacted.

End of Section
SECTION 2L - COFFERDAM OUTLET WORKS

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes all labor, material, and equipment required to install the Upstream Cofferdam Outlet Works. The outlet works shall be furnished by the Contractor complete with all coupling bands, gaskets, connections, cutoff collars, nuts, bolts, control device, control stem with handwheel, control stem support footings, concrete encasement, and all incidentals and shall be installed at the location shown on the Drawings and as specified herein.

This section also includes all labor, material, and equipment required to install the Downstream Cofferdam Outlet Works. The outlet works shall be furnished by the Contractor complete with all connections, connecting hardware, trash racks, control device, control stem with handwheel, control stem supports, footings, concrete encasement, and all incidentals and shall be installed at the location shown on the Drawings and as specified herein.

B. This section is closely related to the following work that is described elsewhere in these specifications:

1. Temporary Environmental Protection Measures at the Dam Site and Diversion and Care of Deer Creek - Section 2A.

2. Fill Placement - Section 2F.

3. Concrete, Class C - Section 3C.

4. Excavation - Open Cut - Section 2C.

5. Clearing and Grubbing - Section 2B.

6. Waste Material Disposal - Section 2G.

1.2 QUALITY ASSURANCE

All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications of AASHTO, ANSI, ASTM, etc. The work in this section shall be performed by journeymen well-versed in the trades involved.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these Specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.
1.4 PRODUCT HANDLING

Contractor shall use all means necessary to protect materials before, during, and after installation. In the event of damage, the Contractor shall make all necessary repairs or replacements to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 UPSTREAM COFFERDAM OUTLET WORKS

A. Corrugated Metal Culvert (CMP) -

1. The corrugated metal pipe shall be 24 inches in diameter, a minimum of 16 gage with corrugations of 2-2/3 inches x 1/2 inch conforming to the requirements of AASHTO M-36, latest edition for the specified sectional dimension and gage.

2. Coupling bands and special sections shall be of the same gage as the corrugated metal pipe. The bands shall be a minimum of 12 inches wide and shall conform to the requirements of AASHTO M-36, latest edition.

3. Gaskets shall be a minimum of 3/8 inch thick x 7 inches wide, constructed of neoprene, and capable of maintaining water-tightness under an exterior head of 40 feet.

4. Cutoff collars shall be 72 inches x 72 inches and shall be a minimum of 16 gage and shall have corrugations of 2-2/3 inches x 1/2 inches conforming to the requirements of AASHTO M-218, latest edition for the specified sectional dimensions and gage.

B. Control Valve or Gate -

1. The control device shall be designed to maintain a water-tight seal between a minimum head of 10 feet and a maximum head of 40 feet.

2. If a control gate is furnished, the gate stem shall be inclined as shown on the Drawings with a handwheel at the top. The stem shall be long enough to permit operation of the control gate from the elevation shown on the Drawings.

3. If a control valve is furnished, the valve stem with handwheel shall be installed in a valve box as shown on the Drawings. The valve stem shall be long enough to permit operation of the control valve from the elevation shown on the Drawings.

4. Supports for the gate stem shall be supplied and installed according to the recommendations of the control gate manufacturer and as approved by the Owner.

C. Footings and Encasement -

All footings and the encasement shall be Class C concrete. Dimensions for concrete items shall be as shown on the Drawings or as approved by the Owner.
2.2 DOWNSTREAM COFFERDAM OUTLET WORKS

A. Pipe -

1. Pipe dimensions shall be as shown on the Drawings. Pipe shall be designed for 20 feet of cover and 20 feet of head.

2. Connections, connecting hardware, and special sections shall be compatible with the pipe. All connections shall be water-tight.

3. Trash rack for the 48" diameter pipe shall be designed to support a load of 500 lbs. and shall have an opening between members of 25 square inches. Trash rack for the 18" diameter pipe shall have an opening between members of 10 square inches. Trash racks shall be secured to pipe as approved by Owner.

B. Control Valve or Gate -

1. The control device shall be designed to maintain a water-tight seal between a minimum head of 5 feet and a maximum head of 20 feet.

2. The control stem shall be vertical with a handwheel at the top. The control stem shall be long enough to permit operation of the control device from the top of the trash rack.

3. Supports for the control stem shall be supplied and installed according to the recommendations of the control device manufacturer as approved by the Owner.

C. Footings and Encasements -

All footings and the encasement shall be Class C concrete. Reinforcing bars shall be Grade 60. Dimensions for concrete items shall be as shown on the Drawings or as approved by the Owner.

PART 3 - EXECUTION

3.1 GENERAL

The length of the pipe is approximate only and is subject to field adjustment. Contractor shall not order pipe until actual length is verified by field measurement.

3.2 BEDDING

A. The pipe shall be bedded in an earth foundation of uniform density and carefully shaped, by means of a template supported at the desired grade, to fit the lower part of the pipe exterior for at least 10% of its overall height.

B. Upstream Cofferdam Bedding -

The bedding material upstream of the core shall be Zone 1 material, the bedding material in the core shall be Zone 1 material, and the bedding downstream of the core shall be Drainage Blanket material.
C. Downstream Cofferdam Bedding -
   Bedding material shall be Zone 1 material.

D. Compaction of all bedding material shall be done in accordance with the requirements of Section 2F of these Specifications.

E. Payment for bedding material and compaction shall not be part of this bid item. Bedding and compaction shall be considered an indistinguishable part of the dam embankment and shall be paid for under the bid items associated with Section 2F of these Specifications.

End of Section
SECTION 2M - PROJECT IDENTIFICATION SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION

This section provides for all labor, material and equipment required to furnish, install, maintain and remove three project identification signs. Work in this section shall be subsidiary to Mobilization and shall be paid for under that bid item.

1.2 QUALITY ASSURANCE

All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers.

1.3 SHOP DRAWINGS

None Required

PART 2 - PRODUCTS

2.1 SIGN PANELS

Sign panels shall consist of 3/4-inch minimum thickness, sanded, exterior grade douglas fir plywood, Grade B-B or better. Sign panel fastenings shall be 3/8-inch diameter machine bolts, nuts, and wrought iron washers.

2.2 POSTS

A. Posts shall be breakaway type, at least 4 inches by 4 inches nominal dimensions or at least 4-inch diameter douglas fir or western larch. Rough-sawn posts or peeled and seasoned timber is acceptable. Posts larger than 6 inches by 6 inches shall not be used.

B. Breakaway holes of the sizes shown below shall be drilled in the posts at the locations shown on Figure 1. The post size shall be measured at the breakaway hole location.

<table>
<thead>
<tr>
<th>Post Size</th>
<th>Number of Holes</th>
<th>Hole Diameter In Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; Diameter</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5&quot; Diameter</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>6&quot; Diameter</td>
<td>2</td>
<td>1/2</td>
</tr>
<tr>
<td>4&quot; x 4&quot;</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4&quot; x 6&quot;</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>6&quot; x 6&quot;</td>
<td>3</td>
<td>1/2</td>
</tr>
</tbody>
</table>

2M-1
2.3 COATINGS

The primer, paint, and stain shall meet the requirements shown on Table 1.

Table 1 - Primer, Paint, and Stain Requirements

<table>
<thead>
<tr>
<th>Type</th>
<th>Color</th>
<th>Federal Specification (Latest Edition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primer, Wood, Exterior</td>
<td>---</td>
<td>TT-P-25</td>
</tr>
<tr>
<td>Primer, Metal</td>
<td>Red Lead Base</td>
<td>TT-P-86 or TT-P-615</td>
</tr>
<tr>
<td>Enamel, Alkyd, Semi-Gloss</td>
<td>White</td>
<td>TT-E-529, Class A</td>
</tr>
<tr>
<td>Enamel, Alkyd, Gloss</td>
<td>Black</td>
<td>TT-E-489</td>
</tr>
<tr>
<td>Stain, Oil; Wood, Semi-Transparent Exterior</td>
<td>Cedar</td>
<td>TT-S-708</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Construction....The sign shall be constructed to the dimensions shown in Figure 1. The exact wording to be put on the sign shall be provided by Owner.

The signs shall be securely bolted to firmly set posts. The top of the signs shall be level, and the posts and sign faces shall be vertical. Signs shall be installed at locations directed by the Owner. Posts shall not extend above the top of the sign panels. The sign panels and posts shall be removed after completion of all project construction and become the property of the Contractor.

B. Painting.....The primer coat and first coat of white paint may be applied by brushing, rollings, or spraying. The finish coat of white paint shall be brushed or sprayed. Each coat must be completely dry before the following coat is applied. The finish coat shall be a semigloss finish, free of brush marks, blisters, wrinkles, or blemishes. The sign letters shall be clear, sharp, of uniform width, free of cracking, scaling, pitting, blistering, or discoloring and shall conform to A.S.A. D6, Standards and Figure 1.

The signs shall be repainted at the start of each construction season. The repainting shall consist of a finish coat free of brush marks, blisters, wrinkles, or blemishes and lettering that is clear, sharp, of uniform width, free of cracking, scaling, pitting, blisters, or discoloring.

End of Section
STATE OF WYOMING
WATER DEVELOPMENT COMMISSION

DEER CREEK DAM
& RESERVOIR

ENGINEER
BANNER ASSOCIATES, INC.
LARAMIE, WYOMING

CONTRACTOR
JOHN DOE CONSTRUCTION
MAIN STREET, USA

PROJECT IDENTIFICATION SIGN
SIGN
FACE, BACK AND EDGES SHALL BE PAINTED WITH ONE
COAT OF PRIME AND TWO COATS OF WHITE PAINT.

LETTERS SHALL BE BLACK ENAMEL FOR ALL LINES.

POSTS
POSTS SHALL HAVE ONE COAT OF CEDAR STAIN.

FIGURE 1
SECTION 2N - TOPSOIL STRIPPING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of stripping, stockpiling, and placing topsoil in accordance with the Specifications. Available topsoil shall be stripped at all locations designated for excavation or embankment.

1.2 DEFINITION

Topsoil shall consist of any soil suitable for the growth of grass or other cover crops reasonably free from hard dirt, clay, rocks, or other materials which would inhibit the germination of seeds or the growth of the cover crop. Classification of soils suitable for topsoil will be at the discretion of the Owner.

PART 2 - PRODUCTS

No products.

PART 3 - EXECUTION

3.1 STRIPPING AND STORING TOPSOIL

Prior to stripping topsoil from the designated areas, brush, grass, agricultural crops, or other suitable material shall be conserved as mulch and incorporated into the topsoil. The material shall be chopped through a brush chopper, shredded by means of a commercial-sized rotary blade mower, or reduced by other approved methods.

Unless it can be placed directly on the prepared slopes, topsoil shall be stockpiled for later incorporation into the work. Stockpiles shall be placed at the location and to the dimensions designated by the Owner.

3.2 PREPARATION OF AREAS

The embankment or cut slope areas to be covered with topsoil shall be completed to the designated lines and grades. Areas that have become crusted or hardpacked shall be scarified to a depth of approximately 3 inches, prior to placement of the topsoil.

3.3 PLACING TOPSOIL

Where topsoil is to be removed for reuse, the Owner will require that existing vegetation will be incorporated into the topsoil. This work will be considered subsidiary to other pay items of the contract, and no measurement for separate payment will be made.

Topsoil shall be placed in a uniform manner to a depth commensurate with the quantity of topsoil available and the area to be covered.

After the topsoil has been spread, large stiff clods, stones, or other
foreign material that would seriously affect the effectiveness or appearance of the topsoil shall be raked up and removed from the area. Topsoil shall be keyed to the underlying material by scarifying.

End of Section
SECTION 20 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

Removal of structures and destruction for permanent roadways, parking lots, and gaging stations shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, fences, structures, cattleguards, culverts, and other obstructions shown on the Drawings, or located in the right-of-way of this work, which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items of the contract.

This work shall also include the salvaging of designated material, as shown on the Drawings, and backfilling the resulting trenches, holes, and pits.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the Contractor.

PART 2 - PRODUCTS

(No Products)

PART 3 - EXECUTION

3.1 GENERAL

The Contractor shall raze, remove, and dispose of all buildings and foundations, structures, fences and other obstructions, any portions of which are on the right-of-way, except utilities and those for which other provisions have been made for removal. All designated salvable material shall be removed, without unnecessary damage, in sections or pieces, which may be readily transported, and shall be stored at specified places within the project limits. Unusable perishable material shall be destroyed. Nonperishable material may be disposed of at approved locations outside the limits of view from the project with written permission of the property owner on whose property the material is placed or in other approved waste disposal sites. Copies of all agreements with property owners shall be furnished to the Owner. Cavities or trenches left by structure removal shall be filled to the level of the surrounding ground and, if within the prism of construction, shall be compacted in accordance with Section 2P.

3.2 REMOVAL OF CULVERTS AND OTHER DRAINAGE STRUCTURES

Culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic in accordance with Section II and Section 2HH.

Unless otherwise directed by the Owner, the substructures of existing structures shall be removed down to the natural stream bottom, and those parts outside of the stream shall be removed one foot below natural
ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Blasting or other operations necessary for the removal of an existing structure or obstruction which may damage new construction, shall be completed prior to placing the new work. In the event blasting cannot be completed prior to placing the new work, the Contractor shall adequately protect the work from damage by the blasting or use such demolition techniques to avoid blasting.

End Of Section
SECTION 2P - SITE GRADING FOR ACCESS ROADS, PARKING LOTS, AND BOAT RAMP

PART 1 - GENERAL

1.1 DESCRIPTION

A. Site Grading—Common. Common material shall be as defined in Section 2C—Excavation—Open Cut and Section 2N—Topsoil Stripping. Site grading—common shall include labor, equipment, topsoil stripping and placement, excavation, haul, stockpiling, rehandling, material segregation, embankment, grading, shaping, compacting, wetting, drying, dewatering, disposal of waste excavated materials, and erosion and pollution control programs for the permanent roadways, parking lots, and boat ramp in accordance with the Drawings and Specifications and as directed by the Owner.

B. Site Grading—Rock. Rock material shall be as defined in Section 2C—Excavation—Open Cut. Site Grading—Rock shall include labor, equipment, excavation, blasting, haul, stockpiling, rehandling, material segregation, embankment, grading, shaping, compacting, wetting, drying, dewatering, disposal of waste excavated materials, and erosion and water pollution control programs for the permanent roadways, parking lots, and boat ramp in accordance with the Drawings and Specifications and as directed by the Owner.

C. Site Grading—Unclassified. Unclassified material shall be defined as unstable or unsuitable materials as determined by the Owner, materials excavated for channel modification beyond the limits of culvert trenching, and materials excavated for irrigation ditch modification or reconstruction. Site grading—unclassified shall include labor, equipment, excavation, disposal, and erosion and water pollution control programs for the permanent roadways, parking lots, and boat ramp in accordance with the Drawings and Specifications and as directed by the Owner.

PART 2 - PRODUCTS

(No Products)

PART 3 - EXECUTION

3.1 GENERAL

All excavation and embankment work shall be constructed reasonably close to the lines and elevations staked by the Owner or shown on the Drawings. No material shall be wasted without permission from the Owner. All grading and related operations shall be conducted so that the terrain outside of the limits of slopes shall not be disturbed, except where approved by the Owner. Prior to the commencement of grading operations, all necessary clearing and grubbing in the area shall have been performed in accordance with Section 2B—Clearing and Grubbing, and stripping shall have been performed in accordance with Section 2N—Topsoil Stripping.
In the excavation where rock, unstable soil, or any other material which is unsuitable for finish work is encountered at subgrade elevation, the Owner may order and pay for additional excavation. Backfill to grade shall be accomplished using materials selected by the Owner. All unsuitable material shall be disposed of as directed.

Wherever practicable, satisfactory materials in the old roadway shall be incorporated into the new roadway and surroundings in order to provide a pleasing appearance from the new roadway. Such roadway obliteration will be measured and paid for as Site Grading-Common.

3.2 CONSERVATION OF MATERIALS

Material consisting of sandy loam, sand, gravel, rock, rock fragments, or a combination thereof encountered within the staked area shall be conserved when so directed by the Owner for selective use in the upper portion of embankments, bedding and backfill of structures, for the construction or plating of fill slopes, for erosion control, or for such other purposes as deemed necessary by the Owner. Cross hauling of such material may be necessary to accomplish the desired purpose. In some instances it may be necessary to stockpile the materials for later use.

The balance of satisfactory roadway excavation shall be used to construct the lower portion of the embankment.

3.3 EMBANKMENT CONSTRUCTION

A. General....Embankment construction shall consist of: constructing roadway and parking lot embankments, including preparation of the areas upon which they are to be placed; construction of dikes, ditch berms, and approaches within or outside the right-of-way; and placing and compacting of approved material within the roadway areas where unsuitable material has been removed. Only approved materials shall be used in the construction of embankments and backfills.

B. Construction Methods.....Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

Embankments shall be constructed from suitable material taken from the designated excavation in conformity with the lines, grades and sections shown on the Drawings. Stumps, trees, rubbish, vegetation, frozen lumps or other unsuitable materials shall not be placed in embankments.

When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankment, the slope of the original hillside, or old fill respectively, shall be benched or stepped by cutting into it horizontally, for a minimum distance of 12 inches to provide for secure bonding of the embankment while it is being brought up in layers. Each bench shall be cut as close to the one below as the slope of the ground will permit. Material thus cut out of the benches shall be incorporated into the new fill at the Contractor's expense.
If it should become necessary, because of weather or other conditions, to suspend grading operations, the entire area worked upon shall be bladed until smooth, free of depressions and ruts, and crowned so that no water can collect or be impounded.

Embankment placed adjacent to structures shall be brought up in equal layers on all sides to prevent distortion of any of these parts. Areas inaccessible to tamping rollers or power rollers shall be compacted by hand or mechanical tampers or other means until the density conforms to adjacent embankment, compacted in accordance with these Specifications.

Embankment which has been subjected to freezing shall be refinished to grade, cross-section and compaction requirements after the frost is out of the ground and the embankment is in suitable condition for work.

All excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments shall be disposed of as directed by the Owner.

Roadway embankment of earth material shall be placed in horizontal layers of approximately 8 inches thickness, prior to compaction, and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain a uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulation will be required to assure uniform density. Water shall be added or removed, if necessary in order to obtain the required density. Construction equipment shall be routed uniformly over the entire surface of each layer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing, or further breaking down the pieces resulting from excavation methods, such material may be placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks, but not greater than 3 feet. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments or earth. The lifts shall not be constructed above an elevation 2 feet below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed as specified for construction of embankments with moisture and density control.

C. Moisture and Density Control...Unless otherwise shown on the Drawings or directed by the Owner, embankments and designated portions of cut sections shall be constructed with moisture and density control. Unless otherwise directed by the Owner, the moisture content of the soil at the time of compaction shall be within plus 2 or minus 4 percentage points of the optimum moisture content as determined by ASTM D1557. Where the materials in the embankment permit practical density tests, such tests will be made in accordance with ASTM D1557.

Within areas of unsuitable materials as shown on the Drawings or as determined by the Owner, earth shall be removed to the depth shown on the Drawings or directed by the Owner, except for the lower 6-inch
layer. This 6-inch layer shall be thoroughly scarified, the moisture content increased or reduced as necessary, and then compacted until the dry density of the compacted material is not less than 90% of the maximum dry density (ASTM D1557). The remainder of the area up to subgrade elevation shall be constructed of suitable material and compacted until the dry density of the compacted material is not less than 95% of the maximum dry density (ASTM D1557).

Foundations for embankments within areas of suitable materials shall be prepared as follows:

1. All vegetable matter and topsoil shall be stripped in accordance with Section 2N. The cleared surface shall be completely broken up by plowing, scarifying or stepping to a minimum depth of 6 inches. The 6-inch layer shall be recompacted to not less than 90% of maximum dry density, after adjusting the moisture content to optimum moisture with the limits described above.

2. If there is no vegetable matter or topsoil to be removed, the existing ground shall be scarified 6 inches deep, and after adjusting the moisture content as in (1) above, recompacted to not less than 90% of maximum dry density.

The remainder of embankments up to subgrade elevation shall be constructed of suitable material compacted to not less than 95% of maximum dry density.

Embankments shall be placed only when ambient temperatures permit the placement and compaction of the materials to the specified densities. Sustained periods of freezing that induce frost into the previously placed material or material being placed shall be cause for suspension of the work.

Density requirements will not apply to the portions of embankments constructed of materials which cannot be tested as specified above.

D. Construction of Embankments Without Moisture and Density Control.....Unless otherwise shown on the Drawings or directed by the Owner, embankments constructed without moisture and density control shall be constructed in accordance with Paragraph B - Construction Methods.

Where end dumping is permitted, the material shall be spread in the thinnest practicable layers, and each layer shall be leveled and compacted as specified in Paragraph B before the succeeding layer is placed.

3.4 FINE GRADING AND COMPACTING SUBGRADE

After the earthwork has been substantially completed and after all culverts, catch basins, etc., have been installed or adjusted to grade, the subgrade shall be brought to the lines, grades, and sections shown on the Drawings, and compacted to the required density.
All soft and unstable material and other portions of the subgrade which, in the opinion of the Owner, cannot be compacted satisfactorily shall be removed to lines and grades as directed by the Owner.

All boulders appearing in the earth excavation shall be removed or broken off to a depth of not less than 4 inches below subgrade. All rock sections shall be brought to grade by depositing a satisfactory cushion material to a depth authorized by the Owner.

If the surface of an old gravel roadbed conforms approximately to the surface of the finished subgrade, such sections shall be scarified superficially for the full width of the subgrade to a depth sufficient to eliminate all depressions and to permit uniform reshaping and compaction.

At all times ditches and drains along the subgrade shall be so maintained as to drain effectively. When ruts of 2 inches or more in depth are formed, the subgrade shall be brought to grade and if necessary be reshaped and rerolled. In no case shall any surface course be placed on a frozen or muddy subgrade. The top 6 inches of the subgrade shall have a minimum compacted density as is specified for embankment.

Until the subgrade has been checked and approved, no surface course shall be laid thereon.

3.5 WATERING

Water, when required, shall be applied at the locations and in the amounts required to properly compact the work. The Contractor is responsible for obtaining and permitting an adequate water supply. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.

In the watering of subgrades and embankments, the Owner may direct the Contractor to apply water in such quantities that the subgrade and embankment shall be compacted at a moisture content in excess of "optimum moisture". When so directed, the amount of water required in excess of "optimum moisture" will not be greater than 2%.

The Contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition, except as directed by the Owner.

3.6 FINISHING

Finish work shall be done in proper sequence with the other operations involved. Wherever practicable, cut slopes shall be blended with the adjacent terrain by rounding the top of slopes in accordance with the dimensions shown on the Drawings.

Erosion control ditches shall be cut to the staked lines and grades, and banks shall be rounded to blend with the adjacent slope.
Shoulders and ditch bottoms shall be cut to eliminate scalloped or ragged lines and to create good drainage patterns.

Ditch slopes and cut slopes shall be trimmed to eliminate unsightly humps or hollows, and shall be blended at pipe ends and erosion control devices.

Debris, unsightly piles of boulders, or rejected material shall be removed and disposed of as directed by the Owner.

Wherever the materials permit, the slopes and ditches shall be given a final uniform appearance by scarifying approximately 6 inches deep, or other approved methods. Where practicable, the finishing operations shall be conducted at a right angle to the slope. Hand raking will be required only where such work cannot be done by machine operations.

Finishing work, including excavation performed for blending of slopes, will not be measured for payment but considered as subsidiary work to other contract items.

3.7 DEWATERING

The Contractor's method of removal of water from foundations shall be subject to the approval of the Owner. The use of a sufficient number of properly screened wells or other equivalent methods will be approved for dewatering. The dewatering shall be accomplished in a manner that will result in construction operations generally being performed in the dry. Dewatering effluent shall not be discharged into waters of the State of Wyoming unless an NPDES discharge permit has been secured for the particular discharge source.

The Contractor shall at all times comply with all water quality permits and regulations as specified in the General Requirements and of these Specifications.

End of Section
SECTION 2Q - AGGREGATES FOR ACCESS ROADS, PARKING LOTS, BOAT RAMP, AND GAGING STATIONS

-------------------------------------
PART 1 - GENERAL
-------------------------------------

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for borrow pit acquisition and permitting, weigh station, borrow pit reclamation, borrow pit haul road construction and obliteration, borrow pit and haul road revegetation, material processing, material segregation, stockpiling, rehandling, haul, placing, wetting, drying, and compaction of aggregate for permanent roadways, parking lots, the boat ramp, and gaging stations in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 BORROW PITS AND MATERIALS

The Contractor is solely responsible for locating borrow pits and acquiring all necessary permits to operate the borrow pits. The Contractor shall provide material samples to the Owner for borrow pit approval. Owner approval shall not relieve the Contractor of his responsibility to provide borrow pits that will produce the required quantity, quality, and gradation of aggregate for the work specified in this section.

PART 2 - PRODUCTS

-------------------------------------

2.1 CRUSHED AGGREGATE SURFACE COURSE

A. General.....Before production of any of the following materials, all vegetation and stripping material shall be removed from the pit. Only designated portions of the pit will be used. The composite materials shall be free from clay balls, vegetable matter, and other deleterious substances, and shall not contain an excess of thin or elongated pieces.

B. Crushed Aggregate Surface Course.....Crushed aggregate surface course shall be crushed stone or crushed gravel and an approved soil binder or natural filler, where required, conforming to the following requirements, unless otherwise designated on the Drawings or elsewhere in the Specifications.

1. Quality Requirements -

<table>
<thead>
<tr>
<th>Description</th>
<th>AASHTO Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Wear</td>
<td>T 96</td>
<td>40 max.</td>
</tr>
<tr>
<td>Durability Index, Coarse &amp; Fine</td>
<td>T 210</td>
<td>35 min.</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>T 89</td>
<td>35 max.</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>T 90</td>
<td>2-9</td>
</tr>
<tr>
<td>Dust Ratio: % Passing No. 200</td>
<td>T 11</td>
<td>2/3 max.</td>
</tr>
<tr>
<td>% Passing No. 30</td>
<td>T 27</td>
<td></td>
</tr>
</tbody>
</table>

2. Gradation... Crushed aggregate surface course shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Percentage Passing</th>
<th>Grading*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sieve</strong></td>
<td><strong>Designation V</strong></td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>95-100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>-</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>45-65</td>
</tr>
<tr>
<td>#4</td>
<td>33-53</td>
</tr>
<tr>
<td>#200</td>
<td>3-12</td>
</tr>
</tbody>
</table>

*Wyoming Highway Department designation.

2.2 STRUCTURAL BACKFILL MATERIAL

Structural backfill shall be placed in accordance with Section 2C.

2.3 SELECT GRANULAR BEDDING

Select granular bedding shall be placed beneath culverts in accordance with Section 2Z, beneath the stilling well bases for both CMP and CMU gage houses, and beneath the boat ramp slab. Select granular bedding shall be a porous, free-draining material consisting of sand, gravel, crushed stone, or other Owner approved free-draining material. The material shall be uniformly graded and of such size that 100% will pass through a 1-1/2 inch sieve and 0-10% will pass through a No. 4 sieve.

2.4 AGGREGATE FOR RIPRAP

Aggregate for riprap shall be hard, durable, crushed, quarried, or natural stone, or broken concrete having an apparent specific gravity of not less than 2.4. The absorption shall not exceed 4%, unless otherwise approved by the Owner. The stone shall be free of weak laminations and cleavages, and shall be of a quality that will not disintegrate on exposure to water or weathering. The aggregate for the various types of riprap shall meet the following additional requirements:

A. Loose Riprap.... Loose riprap stone shall be graded with a sufficient amount of smaller stones uniformly distributed throughout. Rock for riprap shall be no greater than 24 inches in diameter and no less than 6 inches in diameter. Fifty percent of the rock shall be greater than 12 inches in diameter.

B. Gabion Riprap.....Gabion riprap aggregate shall be round or angular stones. No rock shall be less than 3 inches in diameter, nor greater than 12 inches diameter; the rock shall be reasonably well graded between the limiting sizes.
2.5 BEDDING FOR RIPRAP

Bedding for riprap shall be hard, durable particles or fragments of crushed stone or natural gravel, screened or crushed to meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>20-50</td>
</tr>
<tr>
<td>#200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

2.7 STOCKPILED AGGREGATE

A. Description...This work shall consist of storing aggregate material which will be used in construction projects in accordance with the Drawings and Specifications or designated by the Owner.

B. Materials....The aggregate shall meet applicable parts of this section for the type of material required.

C. Construction.....Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the site shall be firm and smooth and well drained. A bed of aggregate suitable to avoid the inclusion of soil or foreign material shall be maintained.

The stockpiles shall be built in layers not exceeding 4 feet in height, and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of fine aggregate composed of material approximately 90% finer than a No. 4 sieve.

Dumping, casting, or pushing over sides of stockpiles will be prohibited.

Stockpiles of different types or sizes of aggregates shall be spaced far enough apart or separated by suitable walls or partitions to prevent the mixing of the aggregates.

Any stockpiling of materials derived by Wet Pit or Dredging operations other than those stockpiles previously mentioned are subject to prior approval of the Owner and must be submitted in the Contractor's plan of operations as specified.

When it is necessary to operate trucks or other equipment on the stockpile in the process of building that stockpile, it should be done in a manner approved by the Owner. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated and failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such
stockpiling procedures. The aggregate shall be transferred from the stockpiles in such a way as to obtain a material having a uniform grading.

2.8 WEIGH STATION

All materials which are to be measured by weight shall be weighed on accurate scales approved by the Owner. Scales shall be accurate to one-half percent of the correct weight throughout the range of use.

PART 3 - EXECUTION

3.1 EQUIPMENT AND CONSTRUCTION METHODS

The equipment and methods utilized in the production, transportation and final placement of aggregate materials shall be such as to provide in place materials meeting all requirements as specified.

3.2 SHAPING AND COMPACTION OF CRUSHED AGGREGATE SURFACE COURSE

A. Each layer shall be compacted to a density of not less than 95% of maximum dry density as determined in accordance with ASTM D1557, unless otherwise called for on the Drawings. Compactions or field-in-place densities will be determined by ASTM D1557. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture and surface is produced and the aggregates firmly keyed. Water shall be uniformly applied over the materials during compaction in the amount necessary for proper consolidation.

B. The methods for placing, shaping, and compacting crushed aggregate surface course on the portions of subgrade that are covered with engineering fabric shall be as recommended by the engineering fabric manufacturer and approved by the Owner. Compaction shall be to the density specified in paragraph A above.

3.3 WEIGH STATION

Scales and scale house shall be furnished, installed, and maintained by the Contractor. All costs associated with the scales, scale house, and equipment testing shall be subsiding to the pay items requiring aggregate.

Prior to the use of scales and as frequently thereafter as the Owner may deem necessary to ensure accuracy, the Contractor shall have the scales checked and approved by competent, qualified personnel under the observance of the Owner.
Scales overweighing shall not be permitted to operate and all materials received subsequent to the last previous correct weighing accuracy test will be reduced by the percentage of error in excess of one-half of one percent. In the event inspection reveals the scales have been underweighing, they shall be adjusted and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

End of Section
SECTION 2R - EXCAVATION AND BACKFILL FOR CULVERTS, CATTLEGUARDS, AND GAGING STATION STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of leveling, excavation, backfill, and disposal of materials required for construction of gaging station structures and installing of culverts and cattleguards in accordance with these Specifications and in conformity with the lines, grades, and typical sections shown on the Drawings or established by the Owner.

1.2 JOB CONDITIONS

The Contractor shall operate his equipment only in the right-of-way easement as directed by the Owner. Indiscriminate operation of equipment outside of this designated area will not be permitted.

PART 2 - PRODUCTS

2.1 AGGREGATES

Materials shall meet the requirements specified in Section 20.

2.2 RIPRAP

Materials shall meet the requirements specified in Section 20.

PART 3 - EXECUTION

3.1 EXCAVATION

A. General...Excavation for structures shall be to the lines and grades shown on the Drawings. Sheeting, shoring, or bracing shall be provided, as required, to protect the excavation, provide safe working conditions, and conform to applicable safety regulations.

B. Procedure -

1. Excavation shall consist of the removal and disposal of whatever substance or material is encountered. The excavation shall be performed in such a manner that the area of the structure site and the areas immediately adjacent to the site will be continuously and effectively drained.

2. Excavation shall be of sufficient size to allow for placing and removal of forms, installation of culverts and structures included in this work, inspection, and backfilling.

3. Shoring, including sheet piling, where required during excavation, shall be installed to protect workmen, banks, structures, and utilities.

4. Excavations will be adequately barricaded to provide for the safety of the workmen and the public and to prevent livestock from entering the
area of the excavation.

5. Any excavation below the subgrade of a structure shall be backfilled to grade with concrete or crushed rock by the Contractor at his own expense.

6. Surplus material from the excavation shall be incorporated into the embankments or disposed of as directed by the Owner.

7. Areas required to be graded shall be constructed true to grade, shall be shaped to drain, and shall be maintained free from extraneous accumulations until final inspection has been completed and the work has been accepted.

8. Slopes on which the riprap is to be placed shall be shaped to allow the full thickness of the specified riprap and any bedding or filter gravel, where required, or as shown on the Drawings. The prepared slopes shall not be steeper than the natural angle of repose of the existing slopes. Whenever possible, the excavation shall be undisturbed material or, where this is not possible, the underlying material shall be compacted to at least 90% of maximum dry density at optimum moisture content in accordance with ASTM D1557.

When called for on the Drawings or in the Specifications, a layer of riprap bedding shall be placed on the slope immediately prior to placement of the riprap stone. The layer shall be shaped to provide the minimum thickness specified. The surface should generally fit the bottom surface of the riprap.

9. Whenever soil incapable of properly supporting the structures, as determined by the Owner, is encountered, such soil shall be removed to the depth required by the Owner, and then properly backfilled with select granular bedding in accordance with Section 20.

3.2 BACKFILL

A. Description.....Structural backfill around structures shall be material from the excavation or borrow material, as specified in Section 2C. Backfill shall not be placed against structures until at least 7 days after placing the concrete and then only after tests have established that the concrete has attained sufficient strength to withstand the pressures indicated.

B. Material.....Select granular bedding beneath slabs and concrete structures shall be granular material as specified in Section 2Q.

Loose riprap shall be as specified in Section 2Q.

Riprap placed in gabions shall be as specified in Section 2Q.

C. Placing.....The approved materials shall be placed in successive horizontal layers of compacted material not more than 6 inches thick where compaction is by rollers or vibrators and 4 inches thick where mechanical tamping is required. Backfill shall be placed evenly on each side of walls to prevent damaging or displacing walls.
For cohesive materials each layer shall be wetted or dried by aeration to a moisture content of 3 to 5 percent above optimum moisture as determined by ASTM D1557. If uniformly graded sands are used, the fill shall be placed completely dry or fully saturated to prevent bulking. Well graded gravel shall be placed at the optimum moisture content.

D. Compaction....When the proper moisture content is obtained, cohesive soils shall be compacted to a density of 90% of ASTM D1557. Where uniformly graded sand or well graded gravel is used for fill, the material shall be compacted to the above density. General compaction of cohesive soils shall be accomplished by rollers or mechanical tampers and compaction of granular materials shall be accomplished by rubber-tired or vibratory equipment.

3.3 PROTECTION OF STRUCTURES

At locations where standing or running water is present in quantities which would interfere with the proper installation of the structure, or saturate the foundation material, the site shall be dewatered and the excavation protected from damage.

3.4 STRUCTURE FOUNDATION

Wherever practicable, and where bedding material is not specified, the installation shall be made on undisturbed material. Where channels or trenches have been excavated below the bottom of the structure, backfill shall be placed in layers of approximately 8 inches in thickness (loose measurement) and each layer shall be uniformly compacted for the full length of installation. The last 6 inch layer of material below the bottom of the structure, or below the bottom of the bedding material, where such material is required, shall be compacted to a minimum density of 90% of ASTM D1557.

End of Section
SECTION 2S – GABIONS

PART 1 – GENERAL

1.1 DESCRIPTION

This work shall consist of rock slope protection enclosed in wire mesh baskets rectangular in shape and of variable sizes. The gabions shall be constructed at the locations indicated, in accordance with these Specifications and in conformity with the lines, grades, and dimensions shown on the Drawings or required by the Owner.

1.2 RELATED WORK

A. Aggregates for Access Roads, Parking Lots, Boat Ramp and Gaging Stations – Section 2Q.

B. Gaging Station Control Structures – Section 2CC.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection.....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 – PRODUCTS

Gabions shall be fabricated in such a manner that the sides, end, lid, and diaphragms can be assembled at the construction site into rectangular baskets of the specified sizes. Gabions are to be of single unit construction; the base, ends, and sides either to be woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection are at least equal to that of the mesh.

Where the length of the gabion exceeds its width, it shall be equally divided by diaphragms, of the same mesh and gauge as the body of the gabions, into cells whose length does not exceed the width.
All perimeter edges including diaphragm edges shall be securely woven or bound so that the joints formed by tying shall have approximately the same strength as the body of the mesh.

Gabions will be supplied, as specified, in various lengths, and heights. The lengths will be multiples (2, 3, or 4) of the horizontal width. The heights will be fractions (1, 1/2, or 1/3) of the horizontal width. The horizontal width shall be not less than 36 inches. All gabions furnished by a manufacturer shall be of uniform width.

All gabion dimensions are subject to a tolerance limit of +3% of the manufacturer's stated sizes.

Wire used in the body of the mesh shall be 11 gauge or greater. Wire used in the mesh shall equal or exceed Federal Specification QQ-W-461e (Steel Numbers 1006, 1010, and 1015), finish 4: medium hardness; Class 3 coating, except that samples for testing shall include at least one sample of each component of the mesh. Uniformity of coating shall equal or exceed 6 one-minute dips by the Preece Test (ASTM A-239). A certification of resistance to corrosion may be substituted in lieu of requirements for Class 3 coating as follows: exposure of a section of mesh, including twists or fastening forming the mesh to salt spray fog test (ASTM B-117) for at least 200 hours before failure of any part of the mesh.

Tie and connection wires shall be supplied in sufficient quantity for securely fastening all edges of the gabion and diaphragms and to provide for four cross connecting wires in each cell whose height is 1/3 or 1/2 the width of the gabion, and 8 connecting wires in each cell whose height equals the width of the gabion. The wire is to meet the same specification as for wire used in the mesh except that it may not be more than 2 gauges smaller.

Openings of the mesh shall not exceed approximately 4 inches in the longest dimension.

Rock used in the gabions shall be as specified in Section 2Q.

Soil anchor stakes shall be steel and may be crane rails of a convenient size, two-inch size steel pipe meeting the requirements of ASTM A120 either black or galvanized, or structural steel angles 3 x 3 x 3/8 inches meeting the requirements of ASTM A36 or better.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

Gabions shall be installed according to the manufacturer's recommendations. The gabions shall be placed on a smooth, unyielding foundation. Final line and grade shall be approved by the Owner. Adjacent gabions shall be tied together with wire ties such that the strength and flexibility at the connections are at least equal to that of the mesh. Empty gabions shall be stretched to provide effective alignment before filling with rock. Each vertical gabion unit and the
interior diaphragms shall be bound together with connecting ties. Alternate placing of rock and connection wires shall be performed until the gabion is filled with specified rock material. Rocks at the top of the basket shall be hand-placed flat rock to provide a uniform base for the next higher tier. Other rocks may be placed by mechanical methods. The lids shall be securely tied to the vertical panels with wire ties.

End of Section
1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for installing engineering fabric over the subgrade and beneath the crushed aggregate surface course at the locations indicated on the Drawings.

1.2 RELATED WORK

A. Site Grading For Access Roads, Parking Lots and Boat Ramp: Section 2P.

B. Crushed Aggregate For Access Roads, Parking Lots, Boat Ramp, and Gaging Stations: Section 2Q.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection...All means necessary shall be taken to protect these materials before, during, and after installation. During all periods of shipment and storing, all fabric shall be maintained, wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperature greater than 140°F, mud, dirt, dust and debris.

B. Replacement...In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

2.1 ENGINEERING FABRIC

Engineering fabric shall be a pervious, woven, non-degradable geotextile made of synthetic fabric manufactured by MIRAFI, Inc., or Owner approved equal. The fabric shall conform to the following properties:
<table>
<thead>
<tr>
<th>Fabric Property</th>
<th>Test Method</th>
<th>Acceptable Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D-1682</td>
<td>300 lb.</td>
</tr>
<tr>
<td>Grab Tensile Elongation</td>
<td>ASTM D-1682</td>
<td>35% (Max)</td>
</tr>
<tr>
<td>Modulus (at 10% Elongation)</td>
<td>ASTM D-1682</td>
<td>140 lb.</td>
</tr>
<tr>
<td>Trapezoidal Tear Strength</td>
<td>ASTM D-1117</td>
<td>120 lb.</td>
</tr>
<tr>
<td>Mullen Burst Strength</td>
<td>ASTM D-3786</td>
<td>600 PSI</td>
</tr>
<tr>
<td>Puncture Strength</td>
<td>ASTM D-3787</td>
<td>130 lb.</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>ASTM D-3884</td>
<td>100 lb.</td>
</tr>
<tr>
<td>Coef. of Permeability, K</td>
<td>CFMC-GET-2</td>
<td>0.01 cm/sec</td>
</tr>
</tbody>
</table>

The fabric shall have good dimensional stability and handling properties and shall be resistant to or not degrade or lose strength due to water, rot, mildew, rodents, insects, ultra violet rays or aging.

The Contractor shall furnish to the Owner, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the manufacturer. The mill certificate or affidavit shall attest that the fabric conforms to the chemical, physical, and manufacturing requirements stated in this section.

PART 3 - EXECUTION

3.1 GENERAL

The engineering fabric shall be shipped, stored, placed, overlapped, and sewn in accordance with the manufacturer's recommendations such that the entire 32 feet width of subgrade is covered and that 2 to 3 feet of overlap occurs along adjoining sides and ends. Engineering fabric shall not be installed until the finished subgrade has been approved by the Owner. Placing, shaping, and compacting crushed aggregate surface course over the engineering fabric shall be in accordance with Section 20.

End of Section
SECTION 2U - OBLITERATION OF ABANDONED ROADWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall includes furnishing all labor, equipment and materials, and ripping, plowing, scarifying, contouring, shaping, and erosion control for obliteration of abandoned roadways at the locations shown on the Drawings.

PART 2 - PRODUCTS

(No Products)

PART 3 - EXECUTION

3.1 OBLITERATION

Sections of the abandoned roadway outside of the site grading limits shall be obliterated where shown on the Drawings. The natural drainage pattern shall be restored. The roadbed shall be ripped, plowed, or scarified to promote the establishment of vegetation, and the slopes shall be rounded to approximately the original contour.

3.2 EXISTING STRUCTURES

Structures shall be broken down, buried, or removed where shown on the Drawings or as directed by the Owner in accordance with Section 20 - Removal of Structures and Obstructions.

3.3 REVEGETATION

Obliterated roadway shall be revegetated as specified in Section 2V - Seeding and Mulching.

End Of Section
SECTION 2V - SEEDING AND MULCHING

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, water, material, and equipment and performing all operations required for preparation of seed bed, seeding, mulching, fertilizing, and installing excelsior matting in disturbed areas in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 METHODS

The Contractor may use any or all of the seeding methods described herein. No separate measurement and payment shall be made for the method used and all methods shall be measured and paid for as seeding and mulching.

1.3 RELATED WORK

A. Topsoil Stripping: Section 2N.

1.4 QUALITY ASSURANCE

Seed, fertilizer, and mulch shall meet the requirements specified herein.

1.5 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.6 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement.....In the event of damage or defect, all necessary replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 SEED AND FERTILIZER

All seed and fertilizer distributed within the state are subject to inspection and analysis, and must be in compliance with the Wyoming Seed Law, the Federal Seed Law, and the Wyoming Fertilizer Laws. Seed must be purchased through a dealer licensed with the Wyoming Department of Agriculture.

A. Labeling.....All seeds shall be furnished in containers and shall be
plainly labeled showing:

1. The commonly accepted name of the kind and variety of seed.

2. The full name and address of the supplier.

3. The percentage of pure seed, crop seed, inert matter, weed seeds by weight, germination, and hard seed.

4. The month and year of the germination test.

5. Origin of seed.

6. Lot number.

7. Name and number of each kind of secondary noxious weed seeds as listed in Wyoming Seed Law. Seed shall not contain any of the primary noxious weed seeds as designated in the Wyoming Seed Law.

8. Net weight of seed in each container.

9. The words "poisonous treated" shall appear in bold print on the label of seeds treated with chemicals which are toxic to either humans or livestock.

B. Certification.....Prior to seeding, the Contractor shall furnish to the Owner duplicate copies of a certification signed by the vendor, certifying that each lot of seed has been tested by a recognized state seed testing laboratory or by a commercial laboratory employing a certified seed analysis technician(s). The seed must have been tested not more than nine months prior to the date of seeding on the project. The nine-month limitation on the date of test shall not apply to hermetically sealed seed when the following conditions have been met:

1. The seed was packaged within nine months after harvest.

2. The container used does not allow water vapor penetration (WVP) through any wall including the seals, greater than 0.05 gram of water per 24 hours per 100 square inches of surface at 100°F with a relative humidity on one side of 90% and on the other side 0%. WVP is measured by the standards adopted by the U.S. Bureau of Standards.

3. The seed in the container does not exceed 8% of moisture on a wet weight basis.

4. The container is conspicuously labeled to indicate 1) that the container is hermetically sealed; 2) that the seed has been preconditioned as to moisture content; and 3) the calendar month and year in which the germination test was completed.

C. Testing.....Hermetically sealed seed must have been tested not more than 36 months prior to the date of seeding on the project. The Contractor shall also furnish to the Owner, duplicate copies of the seed analysis reports as prepared by the respective seed testing laboratory. A
tetrazolium viability test will be accepted in lieu of the germination portion of the service sample seed analysis report as prepared by the respective testing laboratory. The Wyoming Department of Agriculture reserves the right to random sample all seed entering the state. The table of tolerances is as follows:

<table>
<thead>
<tr>
<th>Offered % Pls</th>
<th>Tolerance (In Percentage Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>96% or over</td>
<td>- 5</td>
</tr>
<tr>
<td>90% or over but less than 96%</td>
<td>- 6</td>
</tr>
<tr>
<td>80% or over but less than 90%</td>
<td>- 7</td>
</tr>
<tr>
<td>70% or over but less than 80%</td>
<td>- 8</td>
</tr>
<tr>
<td>60% or over but less than 70%</td>
<td>- 9</td>
</tr>
<tr>
<td>60% or less</td>
<td>-10</td>
</tr>
</tbody>
</table>

If the percent pure live seed (% Pls) of the delivered seed is below the accepted tolerance, and if tested by the Wyoming State Seed Laboratory, the Wyoming State Seed Laboratory test results shall govern, and the seed shall be rejected, and the Contractor shall be required to replace the lot(s) of seed rejected, with seed meeting the offered % Pls at no additional cost to the Owner.

The total percentage of "crop seed" shall not exceed 3% by weight. The species and varieties of seed, or blends of seeds, shall furnish the pure live seed at the rates as called for. No seed which has less than 85% pure seed shall be used unless otherwise approved by the Owner.

D. Fertilizer.....Fertilizer shall consist of a 2:1:1 ratio of nitrogen, phosphorous and potassium.

Fertilizer shall be furnished in new, clean, and sealed containers with the name, weight, and guaranteed analysis of contents clearly marked. Fertilizer failing to meet the specified analysis may be used provided sufficient materials are applied to supply the specified nutrients.

Fertilizer shall be uniform in composition, dry and freeflowing.

The commercial fertilizer shall be certified by the manufacturer to be as specified. It shall be stored in such a manner that its effectiveness will not be impaired.

2.2 MULCH

A. Straw and native hay mulch for drill and broadcast seeding shall consist of small grain straw or native hay. All mulch shall be free of noxious weeds or other seed-bearing weeds that would be detrimental to the seeded area. Mulch in an advanced state of decomposition will not be accepted. Old mulch which breaks in crimping will not be accepted. At least 50% of the mulch by weight shall be 10 inches or more in length.

B. Mulch for hydraulic seeding shall consist of straw, native hay, or wood fibers reduced to the size and texture required for the hydraulic seeding equipment.
C. All materials used as mulch within the State are subject to the inspection and approval of the Wyoming Department of Agriculture.

D. Mulch materials from within the State of Wyoming may be moved intrastate without a certificate of acceptance except where quarantines exist within the weed and pest control districts at time of harvest.

E. Interstate shipments of mulch material must be accompanied by a certificate from the state of origin stating that such shipments are free of noxious weed seeds.

2.3 MULCH TACK

Mulch tack for hydraulic-seeding shall be a commercial mulch tackifier approved by the Owner. Handling and mixing shall be in accordance with the manufacturer's recommendations.

2.5 EXCELSIOR MATTING

The excelsior matting shall consist of an uniform machine-made mat of curled wood excelsior fibers, approximately 80% of which shall be 6 inches in length or longer. The top of the excelsior matting shall be covered with a photodegradable extruded plastic netting. The excelsior matting shall be made smolder resistant without the use of chemical additives.

PART 3 – EXECUTION

3.1 GENERAL

Prior to seeding, the slopes to be seeded shall be completed to the designated line and grade. Topsoil shall be uniformly spread on the prepared slope in accordance with Section 2N. Prior to seeding, the entire seed bed shall be scarified or disked horizontally (level to the eye) to a depth of approximately 3 inches leaving definite furrows. The material shall also be in uncompacted workable condition for seeding. Areas not suitable for scarifying shall be left in a rough condition satisfactory to the Owner during construction to simulate the scarified areas.

The Contractor shall proceed with each seeding operation in its proper sequence and in a continuous manner. Any delay in the Contractor's operations resulting in damage to the prepared slopes or loss of material shall be repaired or replaced at the Contractor's expense.

3.2 DRILLING AND BROADCASTING

A. Time of Seeding....Seeding shall be accomplished between the time the frost leaves the ground in the spring and before the frost enters the ground in the fall with the following exception. Seed may proceed when there is evidence of frost, providing the seedbed can be kept in a workable condition, as approved by the Owner.

B. Drill Seeding.....The Contractor shall first prepare all of the slopes
for seeding. When seeding is done by the drilling method, the drilling of the seed may be done before or after the mulching operations. If fertilizer is called for, it shall be applied after the seeding operation has been completed.

Drills shall be set for uniform rows with the spacing not to exceed 7 inches and also set to distribute the seed at the specified rate. The depth of drilling shall be 1/2 inch to 3/4 inch.

C. Broadcasting....Broadcasting methods will be limited to areas that cannot be effectively seeded by drilling. Areas authorized to be seeded by broadcasting methods shall be scarified. Wherever practicable, scarifying and dragging on the slopes shall be done approximately horizontal (level to the eye).

When seeding is done by the broadcast method, the seed shall be applied first, followed by the mulching operations.

Seed shall not be broadcasted when the weather is windy or otherwise unsuitable for the work.

3.3 HYDRAULIC SEEDING

Seed shall be applied by approved hydraulic methods and by experienced personnel, and shall meet the following requirements.

A. Hydraulic seeding shall be done in the spring or fall when the frost is entirely out of the ground and shall not be done in the summer when hot, dry weather prevails, unless otherwise approved by the Owner.

B. Hydraulic equipment used for the application of the slurry mixtures shall be of a type acceptable to the Owner having built-in agitators that will keep seed, fertilizer, mulch, mulch tack, and water, or various combinations thereof, mixed homogeneously until pumped from the tank. Pump pressure shall be such as to maintain a continuous, non-fluctuating stream of the slurry.

C. The seed, fertilizer, mulch, mulch tack and water shall be combined and applied as specified herein. After the tank is at least one-third full, the mulch and remainder of water shall be added as the slurry is continuously agitated to maintain the homogeneous mixture. When tank is full of water, the seed and fertilizer shall be added and allowed to mix for at least 5 minutes prior to starting application. The seed and fertilizer shall not remain together in the tank for more than 45 minutes. If the 45 minutes is exceeded, the Contractor, at his own expense, shall add additional seed equal to the original amount specified.

D. Mulch shall be divided in half and applied as indicated below under F.

E. Seed, fertilizer, water and approximately 100 pounds per acre of hydraulic mulch, approved by the Owner, shall be mixed and uniformly applied to the areas to be seeded.

The seed shall then be covered with approximately one-half inch of soil
using a clodbuster or other means approved by the Owner on all accessible slopes.

The remaining hydraulic mulch and mulch tack shall then be mixed with water and uniformly applied. This application shall then be accomplished within 36 hours after the first application has been completed.

3.4 STRAW AND NATIVE HAY MULCHING

Straw and native hay mulch shall be uniformly spread over the designated area at the rate as specified herein. The placing of mulch shall begin at the top of the slopes and proceed downward. Straw and native hay mulch shall be used for drill seeding and broadcasting.

Mulch shall be spread with approved equipment that will not pulverize or excessively break down the original size of the individual stems of the mulch. After the mulch has been spread, it shall be anchored in the soil by means of a smooth or serrated coulter disk. Where steep slopes or other factors prohibit the use of equipment, the Owner may direct mulch be spread by hand or covered with excelsior matting to hold the mulch in place. Anchoring operations shall be done horizontally (level to the eye) insofar as possible. When ordered or approved, water may be applied to the mulch material prior to spreading to decrease pulverizing or breaking down the individual stems of the mulch.

3.5 EXCELSIOR MATTING

The excelsior matting shall be applied within 36 hours of the final mulch application. The matting shall be anchored with "U" pins spaced 10 to 15 feet apart.

3.6 APPLICATION RATES

A. Pure Live Seed -

1. Drilling -

<table>
<thead>
<tr>
<th>Kind</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Wheat Grass</td>
<td>10 lbs per acre</td>
</tr>
<tr>
<td>Crested Wheat Grass</td>
<td>6 lbs per acre</td>
</tr>
<tr>
<td>Sweet Clover</td>
<td>2 lbs per acre</td>
</tr>
<tr>
<td>Total</td>
<td>18 lbs per acre</td>
</tr>
</tbody>
</table>

2. Broadcasting.....Double the rates for drilling.

3. Hydraulic Seeding.....Double the rates for drilling.

B. Fertilizer.....The Contractor shall apply a standard commercial fertilizer at the rate of 40 pounds available nitrogen per acre, 20 pounds phosphorus per acre, and 20 pounds potassium per acre.

C. Mulch.....Mulch shall be applied at a rate of 2 tons per acre dry weight
in areas seeded by drilling or broadcasting methods. Application rates for hydraulic mulch shall be as specified herein.

3.7 PRESERVATION OF SEEDED AREAS

The Contractor shall protect seeded areas from damage by traffic or construction equipment. Any area damaged from these causes will be repaired at the expense of the Contractor.

3.8 RESEEDING

Any areas which are not producing required vegetation within one year of the seeding operations shall be reseeded by the Contractor at his expense.

End of Section
SECTION 2W - CATTLEGUARDS

PART 1 - GENERAL

1.1 DESCRIPTION
This work includes all labor, equipment, and excavation, and furnishing and installing the base, grates, wings, delineators, fence "tie-ins", and appurtenances necessary to complete the cattleguards in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 RELATED WORK
A. Excavation and Backfill for Culverts, Cattleguards, and Gaging Station Structures: Section 2R.

B. Structural Steel: Section 5A.

1.3 QUALITY ASSURANCE
All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.4 SHOP DRAWINGS
Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING
A. Protection...All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement...In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PREFABRICATED CATTLEGUARD UNITS
Cross bar members shall be hollow carbon steel structural tubing conforming to requirements of ASTM A501 or A500 (Grade A or B) or cold formed, high tensile, low alloy steel plate which has good weldability. The steel plate shall meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Point</td>
<td>45,000 psi min.</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>60,000 psi min.</td>
</tr>
</tbody>
</table>

Cattleguard supports and detachable wings shall be fabricated from steel meeting the above requirements or from structural steel meeting the requirements of AASHTO M183 (ASTM A36). Bolts shall conform to the
requirements of ASTM A307.

At the Contractor’s option, footings for prefabricated cattleguard units may be precast and installed as shown on the Drawings.

2.2 END POSTS

End posts shall be either treated timber posts or steel posts meeting the requirements of Section 2Y - Barbed Wire Fence.

2.3 SHOP COAT PRIMER


2.4 GREEN FINISH PAINT

Green finish coat paint shall be rust-inhibitive paint meeting the following composition requirements.

A. Paint Composition -

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment, percent by weight</td>
<td>45.0 min.</td>
</tr>
<tr>
<td>Vehicle, percent by weight</td>
<td>55.0 max.</td>
</tr>
<tr>
<td>Weight per Gallon, pounds</td>
<td>11.6 min.</td>
</tr>
<tr>
<td>Coarse Particles and Skins-</td>
<td></td>
</tr>
<tr>
<td>retained on a No. 325 mesh sieve,</td>
<td></td>
</tr>
<tr>
<td>percent by weight of</td>
<td></td>
</tr>
<tr>
<td>pigment</td>
<td>1.0 max.</td>
</tr>
<tr>
<td>Water, percent by weight</td>
<td>0.5 max.</td>
</tr>
<tr>
<td>Fineness of Grind (Hegman Gage,</td>
<td></td>
</tr>
<tr>
<td>North Standard Scale)</td>
<td>3 min.</td>
</tr>
</tbody>
</table>

B. Pigment Composition -

1. The pigment portion shall be made up as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Lead Silico-Chromate, percent by</td>
<td>31.0 to 34.0</td>
</tr>
<tr>
<td>weight</td>
<td></td>
</tr>
<tr>
<td>Zinc Oxide, percent by weight</td>
<td>8.7 to 9.7</td>
</tr>
<tr>
<td>Titanium Dioxide (Type IV), percent by</td>
<td>31.0 to 34.0</td>
</tr>
<tr>
<td>weight</td>
<td></td>
</tr>
<tr>
<td>Chrome Oxide Green, percent by weight</td>
<td>22.0 to 24.0</td>
</tr>
<tr>
<td>Organo Montmorillonite, percent by weight</td>
<td>0.5 to 0.9</td>
</tr>
<tr>
<td>Phthalocyanine Green, percent by weight</td>
<td>2.0 to 2.4</td>
</tr>
<tr>
<td>Durable Tinting Colors (Copper Phthalocyanine Blue; no iron blue allowed)</td>
<td>As needed for shading</td>
</tr>
</tbody>
</table>
2. The extracted pigment, on analysis, shall conform to the following quantitative requirements:

<table>
<thead>
<tr>
<th>Pigment</th>
<th>Percent by Weight</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Oxide</td>
<td></td>
<td>14.2 to 16.7</td>
</tr>
<tr>
<td>Zinc Oxide</td>
<td></td>
<td>8.5 to 9.7</td>
</tr>
<tr>
<td>Titanium Dioxide</td>
<td></td>
<td>24.8 to 34.0</td>
</tr>
<tr>
<td>Chromium Oxide</td>
<td></td>
<td>22.5 to 25.5</td>
</tr>
<tr>
<td>Siliceous Material and Colors</td>
<td></td>
<td>14.1 to 30.0</td>
</tr>
</tbody>
</table>

C. Vehicle Composition -

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent by Weight</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Linseed Oil</td>
<td></td>
<td>10.0 min.</td>
</tr>
<tr>
<td>Alkyd Resin Solid (Type 1, Class A)</td>
<td></td>
<td>43.0 min.</td>
</tr>
<tr>
<td>Mineral Spirits, Drier Catalysts, Dispersing Agents, Anti-skinning Agent</td>
<td></td>
<td>47.0 max.</td>
</tr>
</tbody>
</table>

D. Detail Requirements -

1. The mixed green paint shall be suitable for use as a finish coat on structural steel over a priming coat of basic lead silico-chromate shop coat primer.

   The paint shall dry to a smooth finish with a 60° gloss of 60 minimum.

2. The mixed paint shall dry hard within 24 hours (Method 4061 in Federal Test Method Standard No. 141) when applied at 3 mils wet with a film applicator.

3. The mixed paint shall have a viscosity of not less than 70 nor more than 80 Krebs Units at 70°F using a paddle-type rotor (Method 4281 in Federal Test Method Standard No. 141).

PART 3 - EXECUTION

3.1 GENERAL

   All items in this section shall be constructed at the locations and to the dimensions and grades as shown on the Drawings or as directed by the Owner and according to the methods recommended by the manufacturer.

3.2 DRAINAGE

   Wherever practicable, the area under the unit shall be excavated to provide drainage through the end of the structure opposite the gate.
3.3 PAINTING

A. Cattleguards and wings shall be cleaned in such a manner that all rust, scale, welding slag, spatter, dirt and other substances are removed by the use of metal brushes, scrapers, chisels, hammers or other effective means. Oil, grease and other similar adherent matter shall be removed by washing with a suitable solvent. Blast cleaning will not be required.

B. Cattleguards and wings shall be given one coat of shop coat primer and one coat of green finish paint. Paint may be applied at the shop or in the field except that shop coat paint for shop fabricated cattleguards and wings shall be applied prior to shipment. Both coats of paint may be applied at the shop, if so desired.

C. Paint shall be applied only on thoroughly dry, clean surfaces. Paint shall not be applied when the ambient temperature is below 40°F, when the ambient temperature is expected to fall below 40°F for the drying time but not less than 24 hours, when the air is misty, or when conditions are otherwise unsatisfactory for the work.

D. All painting shall be performed in well lighted areas. Painted surfaces shall be protected from contamination by foreign material during the drying time.

E. All painting shall be done in a neat and workmanlike manner. Paint shall be applied by means of pneumatic spray guns or by brushing. If applied with pneumatic gun, the paint shall be brushed out where necessary and the workmanship shall be at least equal to that obtained by first class brush work. The paint shall be well worked into all joints and spaces. On all surfaces which are inaccessible for paint brushes or guns, the paint shall be applied with sheepskin daubers especially constructed for the purpose.

F. Paint shall be thoroughly mixed by means of mechanical mixers, to keep the pigments in suspension, and shall be kept stirred while being applied.

G. The minimum film thickness of each coat of paint shall be 1.5 mils measured dry with a calibrated magnetic film thickness gauge.

End of Section
SECTION 2X - GUARDRAIL

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials and equipment and performing all operations required for furnishing and installing posts, blocks, corrugated metal beams, end members, reflectors, mounting hardware, and appurtenances necessary to complete guardrail for permanent roadways and parking lots in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The materials shall be free of defects, flaws, or damage incurred during manufacture, transportation, or placement.

1.3 SHOP DRAWINGS

Required shop drawings, as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.4 PRODUCT HANDLING

A. Protection....All means necessary shall be used to protect these materials before, during, and after installation.

B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CORRUGATED METAL BEAM

The rail elements and terminal sections shall be galvanized corrugated sheet steel beams conforming to the requirements of AASHTO M-180, Class A, Type 1.

2.2 GUARDRAIL POSTS AND BLOCKS

Timber guardrail posts and blocks shall be Lodgepole Pine, Ponderosa Pine, West Coast Douglas Fir, or Western Larch. The posts and blocks shall be rough dimensional size. Pretreatment shall conform to the requirements of the AWPA Standards. The preservative used shall be Creosote, Chromated Copper Arsenate, or Pentachlorophenol.

2.3 MOUNTING HARDWARE

All bolts, washers, fittings and accessories shall meet the requirements of ASTM A307, Grade A. All hardware shall be galvanized in accordance
with the requirements of ASTM A153.

2.4 REFLECTIVE SHEETING

Reflective sheeting for the post bolt reflective washers shall consist of glass spheres embedded between a smooth, flexible, transparent plastic and a suitable non-cellulosic backing material. The reflective sheeting shall be silver-white and shall meet the following minimum brightness requirements measured in unit-average candle power per foot candle per square foot:

<table>
<thead>
<tr>
<th>Divergence Angle (°)</th>
<th>Incidence Angle (°)</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>-4</td>
<td>70.0</td>
</tr>
<tr>
<td>0.2</td>
<td>40</td>
<td>14.5</td>
</tr>
<tr>
<td>0.5</td>
<td>-4</td>
<td>30.0</td>
</tr>
<tr>
<td>0.5</td>
<td>40</td>
<td>8.5</td>
</tr>
<tr>
<td>1.5</td>
<td>-4</td>
<td>4.0</td>
</tr>
<tr>
<td>1.5</td>
<td>40</td>
<td>1.5</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 POSTS

Posts shall be set plumb to the lines and grades shown on the Drawings or established by the Owner. Posts in excavated holes shall be set on undisturbed or thoroughly compacted bottom material. Backfill material around the posts shall be placed in thin lifts and each lift shall be thoroughly compacted without displacing the posts from their correct alignment.

3.2 RAIL ELEMENTS

Rail elements shall be erected in a workmanlike manner that will result in a smooth, continuous installation. Elements that are to be placed on curves with a radius less than 150 feet will require shop fabrication to the specified curvature.

End of Section

2X-2
SECTION 2Y - BARBED WIRE FENCE

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for furnishing, and installing 4 strand barbed wire fence, end panels, brace panels, corner bracing, and wire fence gates in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.3 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.4 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 BARBED WIRE

Barbed wire shall meet any one of the following types.

A. Barbed wire shall be galvanized steel wire and barbs conforming to the requirements of ASTM A 121, Class 1 coating, 12-1/2 gauge line wires with 14 gauge two-point round barbs spaced at four inch maximum intervals or four-point round barbs spaced at five inch maximum intervals, double wrapped.

B. Barbed wire shall be galvanized steel wire and barbs conforming to the requirements of ASTM A 121-77, 15-1/2 gauge line wires with 13-3/4 gauge two-point flat barbs at four inch maximum intervals of 16-1/2 gauge four-point round barbs at five inch maximum intervals, double wrapped. Zinc coating for strand wire shall be a minimum of .75 oz/square foot and barb wires shall be a minimum of .70 oz/square foot.

C. Aluminum alloy barbed wire shall be manufactured of aluminum alloy conforming to ASTM B 211, Alloy 5052-0 for the line wire and ASTM B 211,
Alloy 5052-H 38 for the barbs with 12-1/2 gauge line wire wires with 14 gauge two-point or four-point round barbs spaced at five inch maximum intervals, double wrapped.

Wire braces, tie wires, and wire stays shall be not less than 12-1/2 gauge steel. Steel wires shall be galvanized.

2.2 FENCE POSTS

Posts, cross braces, and deadmen shall be cut from sound, growing trees of Douglas Fir, Lodgepole Pine or Ponderosa Pine.

All wood posts shall be peeled and all outer bark removed. There shall be no strip of inner bark remaining which is wider than two inches or longer than three inches.

The line posts shall have not more than a two-inch crook measured from end to end with no multiple crooks. There shall be no dry, heart, or sap rot, and no rotten knots. Season checks shall be limited to a maximum of 3/8 inch.

Posts for end panels and brace panels shall meet all of the requirements for line posts except that the maximum crook shall be one inch.

Conformance with diameter requirements as shown on the Drawings will be checked by average diameters or by circumferential measurement. Posts not pointed will be measured at the top and pointed posts will be measured at the nearest practical circumference accessible at the time of inspection.

Cross braces shall meet the requirements for Structural Joists and Planks, No. 3 Grade in accordance with grading requirements of Section 6A - Lumber. They shall be rough dimensioned, or surfaced. (S4S)

All wood requiring treatment shall be treated in accordance with Section 6A - Lumber, with the following exceptions:

A. The vacuum method of treatment may be used providing that the plant and treatment meet the following requirements:

1. The plant shall be equipped with sufficient gauges or other devices accurately calibrated to measure the amount of preservative retained.

2. The plant shall be equipped with a drying kiln of a volumetric and drying capacity capable of reducing the moisture content of the wood to a maximum of 19 percent in quantities commensurate with the capacity of the treating tank.

3. The treatment shall consist of applying a vacuum to the charge for the time required to remove sufficient air and moisture from the wood cells to provide for the penetration and retention of the preservative solution. The solution shall be heated to 100° prior to use.

4. The quantity of preservative retained after treatment and penetration
shall be in accordance with Section 6A - Lumber.

5. The plant and methods shall be pre-qualified by the Owner.

B. Treating reports shall be submitted in duplicate to the Owner after treatment is completed.

C. Certification for all posts shall be submitted to the Owner in duplicate, prior to use on the project.

D. Steel posts, fittings, hardware, and other appurtenances shall be standard commercial grade, manufactured in accordance with current standard practice, and painted with an approved paint of dark green color. The top six inches of the steel posts may be painted with the supplier’s identification paint.

PART 3 - EXECUTION

3.1 PREPARATION

The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

3.2 INSTALLATION

Wooden fence posts shall be used exclusively except at locations determined by the Owner to be unsuitable for wooden post installation. No separate measurement and payment shall be made for steel posts but shall be measured and paid for as barbed wire fence.

The fence shall be placed one foot outside the right-of-way lines except across streams, crossroads, stock runs or other places where the topography will not permit construction, or where the Owner may direct. All posts shall be plumb and firmly set.

When the erection of the fence will interfere with structure construction or other construction features, a temporary cross fence shall be placed. Quantities involved in constructing and/or removing any temporary fence shall be measured and paid for as temporary fence.

At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of enclosure indicated.

Corner posts, end posts, brace posts, cross braces, line posts and deadmen shall be treated in accordance with paragraph 2.2 above and Section 6A - Lumber.

All line wires will be dead-ended on gate, corner, angle, and line brace posts. The ends shall be wrapped around the post, stapled securely, and twisted back on the stretched wire to prevent the post twisting. Staples will be set at an angle to the post grain and will be driven just deeply enough to snug the line wire without bending. All wire
shall be stretched taut and be installed to the required elevations. Staples shall be 1-1/2", 9 gauge barbed shank staples of approved design.

Line brace panels shall be installed at all breaks in alignment and at least each 1/4 mile.

End panels shall be installed on each side of gates and at locations designated by the Owner.

Corner panels shall consist of two end panels and shall be installed at locations designated by the Owner.

Guy wires should be two complete strands of No. 9 galvanized wire. The guy wires should be tightened by twisting. Wire shall be stretched taut and firmly attached to the posts.

All nailing shall be done without splitting wood, preboring as required; replace all split members. Provide spike penetration into the piece receiving the point of not less than one-half the length of the nail or spike provided.

End of Section
SECTION 2Z - CULVERTS AND STOCKPASSES

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes all labor, equipment, excavation, stream diversion, erosion and pollution control, and furnishing, and installing culverts, stockpasses, bedding, backfill, riprap, and appurtenances in accordance with the Drawings and Specifications or as directed by the Owner.

1.2 RELATED WORK

A. Site Grading for Access Roads, Parking Lots and Boat Ramp: Section 2P.
B. Aggregates for Access Roads, Parking Lots, Boat Ramp, and Gaging Stations: Section 2Q.
C. Excavation and Backfill for Culverts, Cattleguards and Gaging Station Structures: Section 2R.
D. Diversion and Care of Streams Adjacent to or crossing Access Roads and Gaging Stations: Section 2EE.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.
B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CORRUGATED METAL UNITS

The Contractor may furnish and install either corrugated steel pipe or corrugated aluminum pipe. One type shall be used for the entire project.

Corrugated steel units shall be fabricated from galvanized steel sheet.
meeting the applicable requirements of AASHTO M 36.

Corrugated aluminum alloy units shall be fabricated from aluminum alloy sheets meeting the applicable requirements of AASHTO M 196.

Corrugations of the connecting bands and the metal units shall be compatible with the pipe to which they are being attached, unless otherwise approved by the Owner.

2.2 CORRUGATED STEEL PIPE AND PIPE-ARCHES

These conduits and couplings bands shall conform to the requirements of AASHTO M-36S and M-218S with the following exceptions:

A. Fabrication.....Pipe fabricated with resistance spot welded seams shall conform to AASHTO M-36 with the following additions or corrections:

1. Where double welding is required, adjacent welds shall not be closer than two spot weld nugget diameters center to center.

2. Welding shall be performed in such manner that at least 0.6 oz. per square foot of spelter coating is retained on the spot weld and no base metal is exposed when the area adjacent to the weld is wire brushed. Discoloration of the spot weld surfaces will not be cause of rejection.

Pipe fabricated with helical seams shall be fabricated in such a manner that the seams will not affect the shape or nominal diameter of the pipe, and so that they will not create an element of weakness in the pipe. Pipe in which the seams indicate slippage or unravelling shall be rejected.

The butt welded joint at sheet ends will be acceptable if a good weld is performed and damaged spelter coating is satisfactorily repaired as specified herein. Sawed ends will be permitted providing that all burrs are removed and raw edges are coated as specified for the repair of damaged spelter coating.

B. Corrugations -

Corrugations for pipe designated as 2 2/3" x 1/2" and 3" x 1" shall conform to the requirements of AASHTO M-36 and AASHTO M-218.

Corrugations for pipe designated as 3" x 1" shall be not less than 2 3/4 inches nor more than 3 1/4 inches center to center. The corrugations shall have a depth of not less than one inch.

C. Repair of Damaged Spelter Coating -

Units on which the spelter coating has been burned by welding, or otherwise damaged in fabrication or during installation shall be re-galvanized or painted by one full brush coat of zinc-rich paint conforming to military Specification MIL-P-21035 or with a zinc-dust, zinc-oxide, paint conforming to Federal Specification TT-P-641 B Type III. Prior to painting, the surface shall be properly cleaned.
Re-galvanizing shall be done by the hot-dip process or by the metalizing process.

D. Inspection -

Corrugated metal pipe or plates milled, fabricated, or warehoused locally or conveniently will be inspected according to applicable AASHTO designations. In addition, steel culvert pipe or plates fabricated outside of the state and shipped directly to the job site will be accepted based on field inspection plus certified mill reports covering base metal and spelter, when requested.

No culvert will be accepted unless the material is identified by a stamp on each section as outlined in AASHTO M-218.

2.3 STRUCTURAL PLATE

The pipes and bolts and nuts for connecting plates for galvanized structural plate pipe, pipe arches, and underpasses shall meet the requirements of AASHTO M-167.

2.4 CORRUGATED ALUMINUM ALLOY CULVERT PIPE

This pipe shall conform to the requirements of AASHTO M-196 and AASHTO M-197.

A. Corrugations -

Corrugations for pipe designated as 2 2/3" x 1/2" shall conform to the requirements of AASHTO M-196.

Corrugations for pipe designated as 3" x 1" shall conform to the requirements of AASHTO M-196.

2.5 SELECT GRANULAR BEDDING

Select granular bedding for culverts shall be in accordance with Section 2Q.

2.6 RIPRAP

Riprap shall be furnished and installed by the Contractor in accordance with the Drawings and meeting the gradation specified in Section 2Q.

PART 3 - EXECUTION

3.1 EXCAVATION

Trenches or channels shall be excavated in accordance with the requirements of Section 2R - Excavation and Backfill for Culverts, Cattleguards, and Gaging Station Structures.

The completed channel bottom shall be firm for its full length and width; where required, the channel shall have a longitudinal camber.
The amount of camber shall be varied to suit height of fill and supporting soil, but in no case shall it be of an amount sufficient to create a reversal of the pipe gradient.

Where conduits are to be placed in embankment fill, the excavation shall be made after the embankment has been completed to the specified height above the designed grade for those conduits specified on the Drawings.

3.2 BEDDING

A. Soil and Embankment.....Bedding for culverts laid in soil or compacted embankment shall be uniformly compacted earth material to a depth of not less than 10% of the vertical height of the culvert or undisturbed trench bottom excavated to fit the conduit.

B. Rock.....Bedding for culverts laid in rock shall consist of a layer of not less than 4 inches of select granular bedding.

C. Unstable Material.....Bedding for culverts laid in unstable material shall consist of a layer not less than 12" of select granular bedding.

3.3 LAYING CONDUIT

The locations and elevations indicated on the Drawings are approximate. The Contractor shall verify all conduit locations and lengths in the field prior to ordering conduit. A 12-inch minimum cover in subgrade shall be provided for all conduits.

Proper tools and equipment satisfactory to the Owner shall be used by the Contractor for the safe and convenient prosecution of the work. All conduit and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to conduit materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.

The conduit laying shall begin at the downstream end of the conduit line. The lower segment of the conduit shall be in contact with the shaped bedding throughout its full length. Outside circumferential laps of flexible conduits shall be placed facing upstream. Flexible conduit shall be placed with longitudinal laps or seams at the sides.

The invert of structural plate underpasses for livestock shall be placed one foot below existing grade. Excavated material shall be placed and compacted to a depth of one foot inside of the underpasses in accordance with Section 2P.

3.4 JOINING CONDUIT

Flexible conduits shall be firmly joined by coupling bands.

Conduit shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced.
3.5 BACKFILLING

After the conduit has been installed, backfill material shall be placed and compacted in accordance with Section 2R.

End of Section
SECTION 2AA - TRAFFIC CONTROL SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for furnishing and installation of permanent traffic control signs, posts, mounting hardware, and appurtenances in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.3 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.4 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS


PART 3 - EXECUTION

3.1 INSTALLATION

Installation of signs, posts, mounting hardware, and appurtenances shall be of the types and at the locations indicated on the Drawings and shall be constructed and installed in accordance with the documents referred to in Part 2 above.

End of Section

2AA-1
SECTION 2BB - GAGE HOUSE SHELTERS, STILLING WELLS, AND APPURTEANCES

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for furnishing, transportation, installation, and construction of concrete masonry unit (CMU) gaging station shelters, solar and electrical systems, concrete stilling wells, corrugated metal pipe (CMP) gaging station shelters, CMP stilling wells, piping, valves, and appurtenances in accordance with the Drawings and Specifications. Locations of the gage houses shall be staked in the field by the Owner.

Facilities at each gaging station shall include the following:

<table>
<thead>
<tr>
<th>Gaging Station Name</th>
<th>CMU Shelter</th>
<th>CMP Shelter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Creek Above Reservoir</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Davis Creek</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>King Creek</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Duck Creek</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>West Fork Deer Creek</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deer Creek in Canyon</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deer Creek in Glenrock</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

1.2 RELATED WORK

A. Excavation and Backfill for Culverts, Cattleguards, and Gaging Station Structures: Section 2R.

B. Culverts and Stockpasses: Section 2Z.

C. Gaging Station Control Structures: Section 2CC.

D. Concrete Formwork: Section 3A.

E. Concrete Reinforcement: Section 3B.

F. Cast-in-Place Concrete: Section 3C.

G. Concrete Appurtenances: Section 3D.

H. Unit Masonry: Section 4A.

I. Painting: Section 9B.

J. Stream Gaging Equipment: Section 10L.

K. Instrumentation and Control Systems: Section 16F.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally
recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CMU GAGE HOUSE

The 8-inch cavity walls of the gage houses shall be constructed of concrete masonry units in accordance with the Drawings and Specifications.

2.2 FLOOR HATCH AND STEPS

The gage house floor hatches shall be NEENAH Series R-6660-KP square slab type manhole frame and solid lid with Type R exposed butt hinges or Owner approved equal. Steps shall be NEENAH cast iron manhole steps conforming to all applicable safety standards, or Owner approved equal.

2.3 BLOCK-OUT COVER

An 8" x 14" x 1/4" galvanized steel plate with a finger hole for removal shall be provided for the stem operator block-out in each CMU gage house.

2.4 SHELVING

Plywood shelving on an angle iron frame shall be installed as shown on the Drawings.

2.5 GALVANIZED STEEL PIPE AND FITTINGS

Galvanized steel pipe and fittings shall be in accordance with ASTM A53 for Schedule 40, Grade B, with threaded ends.

2.6 INTAKE STATIC TUBES

Intake static tubes shall be fabricated by the Contractor from galvanized steel pipe in accordance with the Drawings and Specifications.
2.7 BALL VALVES

All ball valves shall be DeZurik Series 400 or Owner approved equal. The Contractor shall furnish and install the ball valves, wrenches, extension rods, fittings, and incidentals necessary to complete this item in accordance with the Drawings and Specifications.

2.8 FLUSH TANK

The Contractor shall furnish and install a steel flush tank, brackets, fittings, and incidentals, in accordance with the Drawings.

2.9 DOOR

The Contractor shall furnish and install locking swing doors complying with U.S. Department of Commerce Standard #PS4-66 for 1-3/4" thick Flush Steel Doors and Frames, Federal Specification No. RR-D-575a. The door leaves shall be 20 gage zinc-coated steel, 1-3/4" full flush type. Door frames shall be 16 gage zinc-coated steel with double rebbited 4-3/4" jamb. Weatherstripping shall be jam-up type, extruded aluminum with vinyl insert, applied to door frame stops. All nuts, bolts, washers, and sheet metal screws shall be cadmium-plated steel. The lock shall be mortise cylinder type, legal exit lock (Federal Specification #FFH-116c, Government Type #T-2127, dull chrome #US26D finish). The door shall open to the inside.

2.10 CONCRETE FOR BUILDING CONSTRUCTION

Concrete for building construction shall conform to the requirements indicated in these Specifications. Concrete shall be Class "B" with minimum ultimate compressive strength at 28 days of 4000 psi. Aggregate size shall be that specified for "thin sections".

2.11 PREFABRICATED CMP GAGE HOUSE

Prefabricated CMP Gage Houses shall be of the type and size indicated on the Drawings. The Contractor shall supply and install a 48-inch diameter, 14 gauge CMP gage house structure consisting of the housing, roof, door, door latch, shelving supports, and appurtenances as manufactured by Thompson Pipe and Steel Co., Standard Gaging Station Shelter Drawing No. 4493, or Owner approved equal.

2.12 CMP STILLING WELL

The stilling wells for the CMP gage houses shall be constructed of 48-inch diameter CMP of the same type and gauge as the CMP gage house and as shown on the Drawings.

2.13 CMP STILLING WELL LADDER

The CMP stilling well ladder shall be fabricated by the Contractor in accordance with the Drawings or in a manner approved by the Owner.
2.14 SOLAR AND ELECTRICAL SYSTEMS

Solar and electrical systems for the CMU gage houses shall be in accordance with the Drawings and Specifications, Section 16F.

PART 3 - EXECUTION

3.1 GENERAL

All items in this section shall be constructed at the locations staked in the field by the Owner and to the dimensions, elevations, and grades as shown on the Drawings or as directed by the Owner and according to methods recommended by the manufacturers.

3.2 FLOOR HATCH

The manhole frame and lid shall be installed flush with the finished floor at the gage house and in a position such that the gage house door will fully open with the manhole lid in the open or closed position.

3.3 PIPING

The Contractor shall install the piping between the stilling wells and the streams at the elevations shown on the Drawings or as directed by the Owner and with no slopes. Any deviations of elevation and slopes shall result in the removal and reinstallation of material where necessary to achieve proper elevations and slopes at the expense of the Contractor. Holes drilled through the stilling well for pipes to the stream and flush tank shall be sealed watertight by grouting with cement after the piping has been installed.

3.4 CMP STILLING WELL

A concrete base for the CMP stilling well shall be constructed as shown on the Drawings. The CMP stilling well shall be set into the base while the concrete is still wet. The concrete shall be worked in such a manner to provide a tight bond between the CMP and the concrete. The stilling well shall be supported in a straight and true alignment until the concrete base has cured sufficiently.

3.5 COUPLING BAND

The CMP gage house and the CMP stilling well shall be connected by a standard coupling band for the size and type of CMP used in this work.

3.6 SOLAR AND ELECTRICAL SYSTEMS

Solar and electrical systems for the CMU gage houses shall be installed in accordance with the Drawings and Specifications, Section 16F.

3.7 PAINTING

Painting of the CMU gage house doors, flush tanks, and the CMP gage house shelters shall be in accordance with Section 9B.

End of Section 2BB-4
SECTION 2CC - GAGING STATION CONTROL STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operation required for furnishing, transportation, construction, and installation of concrete control structures and Parshall Flumes in accordance with the Drawings and Specifications. Locations of the control structures shall be staked in the field by the Owner. Control structures at each gaging station shall include the following:

<table>
<thead>
<tr>
<th>Gaging Station Name</th>
<th>Concrete Control Structure</th>
<th>Parshall Flume</th>
<th>No Structure Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Creek Above Reservoir</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Davis Creek</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>King Creek</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Duck Creek</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>West Fork Deer Creek</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Deer Creek in Canyon</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deer Creek in Glenrock</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

1.2 RELATED WORK

A. Aggregates for Access Roads, Parking Lots, Boat Ramp, and Gaging Stations: Section 2Q.

B. Excavation and Backfill for Culverts, Cattleguards, and Gaging Station Structures: Section 2R.

C. Gabions: Section 2S.

D. Gage House Shelters, Stilling Wells and Appurtenances: Section 2BB.

E. Diversion and Care of Streams Adjacent to or Crossing Access Roads and Gaging Stations: Section 2EE.

F. Concrete Formwork: Section 3A.

G. Concrete Reinforcement: Section 3B.

H. Cast-in-Place Concrete: Section 3C.

I. Concrete Appurtenances: Section 3D.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made of nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage, or placement.
1.4 SHOP DRAWINGS

Required shop drawings, as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation in accordance with these Specifications.

B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

1.6 COORDINATION

The Contractor shall coordinate the work of this section with the installation of the gage houses as specified in Section 2BB, maintaining correct elevations of structures and piping.

PART 2 - PRODUCTS

2.1 PARSHALL FLUME

All required gaging station Parshall flumes shall be 2'-6" throat width Parshall measuring flumes with manufacturer installed rustproof staff gage and wing walls as manufactured by Thompson Pipe and Steel Company or Owner approved equal, and in accordance with the Drawings and Specifications.

2.2 GABIONS

Gabions, ties, and stakes for bank protection at the concrete control structures shall be manufactured in accordance with Section 2S.

PART 3 - EXECUTION

3.1 GENERAL

All items in this section shall be constructed at the location staked in the field by the Owner and to the dimensions, elevations, and grades as shown on the Drawings or as directed by the Owner, and in accordance with these Specifications and methods recommended by the manufacturer.

3.2 STREAM DIVERSION

The Contractor shall divert stream flows during construction of the control structures in accordance with Section 1J and Section 2EE.

3.3 CONCRETE CONTROL STRUCTURES

The concrete control structures shall be constructed using Class "B" concrete in accordance with the Drawings and Specifications. Loose riprap meeting the gradation requirements of Section 20 shall be placed
adjacent to the control structure in accordance with the Drawings and Specifications.

3.4 GABIONS
-------
Gabions shall be filled with gabion riprap aggregate and placed and secured at the locations indicated on the Drawings or as directed by the Owner in accordance with these Specifications, Section 2Q, and in a manner recommended by the manufacturer.

3.5 PARSHALL FLUMES
------------------
The Parshall flumes shall be installed at the orientations and elevations shown on the Drawings. The level flume floor shall be horizontal, and the piping between the CMP stilling wells and the flumes shall be horizontal and at the correct elevations. The flumes shall be anchored with Class C concrete in accordance with the Drawings and Specifications. The Contractor shall, in a manner approved by the Owner, provide necessary support for the flume to prevent changes in orientation or elevation during concrete placement. Should the orientation or elevation be incorrect, remedial measures approved by the Owner shall be made at the expense of the Contractor.

3.6 CHANNEL MODIFICATION
---------------------------
Channels shall be graded or modified in accordance with the Drawings and Specifications. Modified stream banks shall be reshaped to the same slopes of the existing banks and shall be protected by a 3" layer of riprap bedding overlain by a 12" layer of riprap in accordance with the Drawings and Specifications, Section 2Q.

End of Section
SECTION 2DD - GAGING STATION CABLEWAY

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for furnishing, transportation, construction, and installation of welded steel A-frame type cableways with associated cablecar and anchors. Cableways and associated items shall be constructed at the Deer Creek in Glenrock, Deer Creek above Deer Creek Reservoir, and West Fork Deer Creek gaging station sites in accordance with the Drawings and Specifications. Locations of the cableways shall be staked in the field by the Owner.

1.2 RELATED WORK

A. Rock Reinforcement: Section 2I.
B. Excavation and Backfill for Culverts, Cattleguards, and Gaging Station Structures: Section 2R.
C. Concrete Formwork: Section 3A.
D. Concrete Reinforcement: Section 3B.
E. Cast-in-Place Concrete: Section 3C.
F. Concrete Appurtenances: Section 3D.
G. Structural Steel: Section 5A.
H. Miscellaneous Metal: Section 5B.
I. Lumber: Section 6A.
J. Painting: Section 9B.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made of nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage, or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation in accordance with these Specifications.
B. Replacement.....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

Structural steel shall conform to ASTM A36 and in accordance with the Drawings and Specifications.

2.2 BOLTS, NUTS, AND WASHERS

Bolts and nuts shall be American National coarse-thread series. Unfinished bolts and nuts shall conform to ASTM A307 and shall be regular hexagon-bolt type. Round washers shall conform to USA Standard B27.2, Type B.

2.3 CABLE

The cable shall conform to the standard 3/4" diameter, regular lay, 6x7 fiber core, bethanized marine cable manufactured by Bethlehem Steel, or Owner approved equal. The cable shall be of plow steel with a breaking strength of not less than 35,000 pounds.

2.4 FASTENING HARDWARE

All fastening hardware shall be of galvanized drop-forged steel construction to the standards as manufactured by Bethlehem Steel, or Owner approved equal. The fastening hardware shall be of sufficient strength to conform with the cable specified herein. No welds shall be permitted on any parts of eyebars, anchorage rods, or turnbuckles.

2.5 ROCK BOLTS

Rock bolts, eye bolts, and accessories shall be in accordance with the Drawings and Specifications, Section 2I. The design load of the bolts shall be 22,000 lbs. (min.). Eye bolts shall have a safe working capacity of 22,000 lbs. (min.).

2.6 LUMBER

Lumber for the cable car shall be as specified on the Drawings and in Section 6A.

PART 3 - EXECUTION

3.1 GENERAL

All items in this section shall be constructed at the locations staked in the field by the Owner and to the dimensions, elevations, and grades as shown on the Drawings or as directed by Owner and in accordance with these Specifications and methods recommended by the manufacturers.
3.2 CONCRETE FOOTINGS AND ANCHOR BLOCKS

Concrete footings and anchor blocks shall be pre-cast or cast-in-place concrete in accordance with the Drawings and Specifications. Excavation and backfill for these structures shall be in accordance with Section 2R.

3.3 FABRICATION OF WELDED A-FRAME

A. General....Structural material shall be fabricated and assembled in the shop to the greatest extent possible. Shearing, flame cutting, and chipping shall be done carefully and accurately. Sole plates of beams shall have full contact with the flanges. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by reaming operations.

B. Connections.....Connections shall be as indicated. One-sided or other types of eccentric connections will not be permitted unless shown in detail and approved on the shop drawings.

C. Holes.....Holes shall be cut, drilled, or punched at right angles to the surface of the metal and shall not be enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling or reaming operation shall be removed with a tool making a 1/16-inch bevel.

D. Welding.....Welded connections will be permitted where indicated. Welded construction shall conform to the AISC Specification for the Design, Fabrication and Erection of Structural Steel Buildings.

E. Bolts and Nuts.....Bolts shall be driven accurately into the holes without damaging the thread. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off. Unfinished bolts shall be of a length that will extend entirely through but not more than 1/4 inch beyond the nuts. Bolt heads and nuts shall be drawn tightly against the work with a suitable wrench not less than 15 inches long. Bolt heads shall be tapped with a hammer while the nut is being tightened. After having been fully tightened, nuts shall be locked.

F. Bushed Pulleys.....The bushed pulley shall be installed to provide free rotation in either direction.

3.4 ERECTION OF WELDED A-FRAME

A. General.....Fasteners shall be installed as specified herein. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately, and the approval of the method of correction shall be obtained.
B. Anchor Bolts and Anchors.....Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

C. Column Bases and Bearing Plates.....Column bases and bearing plates shall be provided under columns. Base plates and bearing plates shall be supported and aligned on steel wedges or shims. After the supported members have been plumbed and properly positioned and the anchor nuts tightened, the entire bearing area under the plate shall be damp-packed solidly with nonshrink bedding material. Wedges and shims shall be cut off flush with edge of column base and bearing plate, and shall be left in place.

D. Field Assembly.....After assembly, the various members forming parts of a completed frame or structure shall be aligned and adjusted accurately before the members are assembled. As erection progresses, the work shall be securely fastened to take care of all dead load, wind, and erection stresses. Splices will be permitted only where indicated. Holes shall not be enlarged more than 1/16 inch greater than the specified hole size without approval.

E. Driftpins.....Driftpins may be used only to bring together the several parts and shall not be used in such a manner to distort or damage the metal.

F. Gas Cutting.....The use of a gas-cutting torch in the field of correcting fabrication errors will not be permitted on any major member in the structural framing.

3.5 CABLE

The Contractor shall install and erect the cable and fastening hardware in accordance with the Drawings and Specifications. The cable shall be tensioned to allow a 4-foot sag under a load of 1,500 pounds at the center of the span.

3.6 ROCK BOLTS

Rock bolts, eye bolts, and appurtenances shall be installed and tested in accordance with the Drawings and Section 2I of these Specifications.

3.7 CABLE CAR

The cable car shall be constructed and suspended in accordance with the Drawings.

3.8 PAINTING

Painting of the metal and wood surfaces of the cableways and the cable cars shall be in accordance with Section 9B.

End of Section
SECTION 2EE - DIVERSION AND CARE OF STREAMS ADJACENT TO OR CROSSING
ACCESS ROADS AND GAGING STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

The Contractor shall not interrupt the natural flow of watercourses through the construction sites.

The Contractor shall furnish, install, maintain and operate all necessary equipment for diversion of streams, except where specified otherwise, for diverting water from the various parts of the work as required for constructing each part of the work.

After having served their purpose, all temporary protective works shall be removed or graded so as not to interfere in any way the flow and quality of the streams or with the operation or usefulness of the structures.

1.2 WATER QUALITY

The Contractor shall comply at all times with all water quality permits and regulations as specified in the General Requirements, Section 1J of these Specifications. The Contractor is solely responsible for failure to comply.

PART 2 - PRODUCTS

(NO PRODUCTS)

PART 3 - EXECUTION

3.1 METHOD OF DIVERSION

Except where the method of diversion is specified, the Contractor's method of diversion of streams from construction work shall be subject to the approval of the Owner. The diversion shall be accomplished in a manner that will result in construction operations generally being performed in the dry. Completed concrete work shall be given sufficient time to cure prior to redverting the channel.

3.2 DISPOSAL OF DEBRIS

All construction debris shall be disposed of on land in such a manner that it cannot enter into the watercourse.

3.3 DELETERIOUS MATERIALS

The Contractor's construction activities shall be performed by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, and other objectionable pollutants and wastes into streams, flowing or dry watercourses, and underground water sources in accordance with Section 1J.

2EE-1
3.4 STREAMBANK SLOPING

All streambank sloping shall be done away from the river, and the use of construction machinery in watercourses shall be kept to a minimum.

3.5 BLOCKAGE

No side channels, tributaries, or backwater areas shall be blocked off by riprap.

3.6 CLEARING

Clearing of vegetation along the watercourses shall be limited to that necessary for construction of the project.

3.7 RIPRAP

Only clean rock material from a non-streambed source shall be utilized for riprap in order to avoid the percolation of fines which would result in excessive turbidity.

3.8 CLEANING OF VEHICLES

Concrete trucks shall be washed at a site and in such a manner that washwater cannot enter the watercourse.

3.9 COORDINATION

Close coordination shall be maintained by the Contractor with downstream users, advising them of any water quality changes.

End of Section
SECTION 2FF - BOAT RAMP AND PARKING LOTS

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for constructing the boat ramp and parking lots in accordance with the Drawings and Specifications.

1.2 RELATED WORK

A. Site Grading for Access Roads, Parking Lots, and Boat Ramp: Section 2P.
B. Aggregates for Access Roads, Parking Lots, Boat Ramp, and Gaging Stations: Section 2Q.
C. Guardrail: Section 2X.
D. Concrete Formwork: Section 3A.
E. Concrete Reinforcement: Section 3B.
F. Cast-in-Place Concrete: Section 3C.
G. Concrete Appurtenances: Section 3D.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The materials shall be free of defects, flaws, or damage incurred during manufacture, transportation, storage, or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be used to protect these materials before, during, and after installation.
B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner, at no additional cost to the Owner.
PART 2 - PRODUCTS

2.1 ELEVATION MARKERS

Elevation markers shall be 2 inch diameter flat top brass markers Model No. M/M-B2 as manufactured by SURV-KAP, or Owner approved equal.

2.2 GUARDRAIL

Guardrail shall be in accordance with Section 2X - Guardrail.

PART 3 - EXECUTION

3.1 GENERAL

All items in this section shall be constructed in accordance with the Drawings and Specifications.

End of Section
SECTION 2GG – REVEGETATION OF DAM AREA

PART 1 – GENERAL

1.1 DESCRIPTION

The work in this section shall consist of providing all labor, water, material, and equipment and performing all operations required for depositing topsoil, for seed bed preparation, seeding, mulching, fertilizing, and installing excelsior matting in disturbed areas within the dam area in accordance with the Drawings and Specifications and as directed by the Owner.

1.2 DEFINITION

Topsoil shall consist of any soil suitable for the growth of grass or other cover crops reasonably free from hard dirt, clay, rocks, or other materials which would inhibit the germination of seeds or the growth of the cover crop. Classification of soils suitable for topsoil shall be at the discretion of the Owner.

1.3 QUALITY ASSURANCE

Seed, fertilizer, and mulch shall meet the requirements of Section 2V.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with Section 1.D of the General Requirements of these specifications.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials before, during, and after installation.

B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 SEED

The Contractor shall furnish and sow the pure live grass seed mixture in accordance with Section 2V.
2.2 FERTILIZER

The Contractor shall apply a standard commercial fertilizer in accordance with Section 2V.

2.3 HYDRAULIC MULCH

Hydraulic mulch shall be in accordance with Section 2V.

2.4 MULCH TACK

Mulch tack for hydraulic-seeding shall be in accordance with Section 2V.

2.5 EXCELSIOR MATTING

The excelsior matting shall be in accordance with Section 2V.

PART 3 - EXECUTION

3.1 PLACING TOPSOIL

Topsoil shall be placed in a uniform manner to a depth commensurate with the quantity of topsoil available and the area to be covered.

After the topsoil has been spread, large stiff clods, stones, or other foreign material that would seriously impair the effectiveness or appearance of the topsoil, shall be raked up and removed from the area.

3.2 HYDRAULIC SEEDING

Hydraulic seeding shall be in accordance with Section 2V.

3.3 RESEEDING

Reseeding shall be in accordance with Section 2V.

End of Section
SECTION 2HH - TRAFFIC CONTROL DURING CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for traffic control where construction operations interfere with, obstruct, or create a hazard to, the movement of traffic.

PART 2 - PRODUCTS

2.1 MATERIALS

All barricades, warning signs, temporary signals, and other protective devices shall conform to the provisions for Construction Signing in accordance with the manual on "Uniform Traffic Control Devices for Streets and Highways", current edition, published by the Federal Highway Administration and applicable Wyoming Highway Department requirements. Materials used for the fabrication or erection of such devices shall be approved by the Owner before use on the project. All materials used for traffic control shall remain the property of the Contractor.

PART 3 - EXECUTION

3.1 GENERAL

The Contractor's responsibility for the maintenance of traffic shall begin on the day work starts on the project. The Contractor shall provide and maintain in a safe condition temporary approaches and crossings, and intersections with trails and roads. All lanes that are being used for maintenance of traffic, including those on detours and temporary facilities, shall be adequately maintained with a substantial surface under all weather conditions.

3.2 BARRICADES AND WARNING SIGNS

The Contractor shall provide, erect, and maintain barricades, lights, danger signals, and other traffic control devices, and shall take all reasonable precautions for the protection of the work and safety of the public. The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road.

3.3 FLAGGING

When construction work is performed under traffic, the Contractor shall provide for safe movement through construction work by flagpersons. The Flagging Code as adopted by the Wyoming Highway Commission and made a part of the Wyoming Manual on Uniform Traffic Control Procedures shall be adhered to at all times.

End of Section 2HH-1
SECTION 2II - TYPE 1 FIELD LABORATORY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work includes furnishing and installing a Type 1 field laboratory for the duration of permanent roadway and parking lot construction for use by the Owner and his representative in accordance with the Specifications.

B. The field laboratory shall be a portable building or trailer generally meeting the following dimensions and requirements. The field laboratory shall be equipped with a permanent identification plate for verification by the Owner. All dimensions indicated herein will have an allowable tolerance of plus or minus ten percent unless otherwise indicated. All minor deviations from these requirements will require prior written approval by the Owner. The laboratory shall be located as shown on the Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

The field laboratory shall be equipped with sanitary facilities which may be furnished as an integral part of the laboratory building or as a separate unit. If a separate unit is furnished, it shall be locked and the keys given to the Owner or his representative. The holding tank shall be chemically treated. If local ordinances permit open pit installations, the Contractor may use this method.

The facilities shall have the following minimum dimensions:

- Height: 84"
- Base: 44" x 44"
- Roof: 36" x 36"
- Door: 74" x 26"
- Holding Tank: 50 gallons

2.2 FIRE EXTINGUISHER

The field laboratory shall be equipped with a 10-pound ABC with a 20 BC rating, multi-purpose, stored pressure, dry chemical type fire extinguisher mounted on a wall inside the laboratory.

2.3 STEPS AND PLATFORM

Stair steps and an entrance platform with safety railing along the stair steps and around the platform shall be provided for both doors. The stairs and platforms shall be constructed in such a manner and of such size that the doors can be opened by a person on the platform adjacent to the door.
2.4 TYPE 1 LABORATORY

A. Floor Space.....8 feet wide by 26 feet long minimum (outside dimensions).

B. Ceiling Height.....7 feet.

C. Floor.....The floor shall be rigidly supported and covered with tile, linoleum or other approved smooth surface approved by the Owner. Floor surfaces shall be free from rough or broken tile or linoleum.

D. Walls and Ceiling.....Walls and ceiling shall be finished with a hard surface material.

E. Counter Space.....Counter space shall contain a minimum of 60 square feet with a smooth top constructed 30 inches deep and a minimum of 38 inches high. Surfaced with tempered masonite, formica or linoleum. A shelf 18 inches wide shall be constructed 2 feet below the counter top for the entire length of the counter. In the square feet of counter area, provisions shall be made for a writing surface. This writing surface shall be 30 inches high with three drawers on each end and provisions for knee space.

F. Doors.....The laboratory shall be equipped with two tight closing doors that are a minimum of 30 inches wide and are positioned to open outward. The doors shall be equipped with locking panic exit devices that are approved by Underwriter Laboratories. The Yale-1530 Mortise Lock Exit Device and the Sargent Mortise-9300 Series Exit Device are approved for use in the Field Laboratory. Other panic exit devices will be allowed for use as approved by the Owner.

G. Windows.....Six tight sealing windows, two each long side and one at each end. Each window shall have a minimum area of four square feet with provisions for locking.

H. Screens.....Provided for each window opening not fitted with air conditioning.

I. Insulation.....All walls, ceilings and floors.

J. Sinks.....One 18 inch by 30 inch by 5-1/2 inch flat rimmed, porcelanized metal, stainless steel or galvanized metal. The sink shall be installed in the counter top and equipped with a faucet and waste discharge pipe to outside.

K. Emergency Eye Wash Stations.....A 19 inch by 19 inch by 24-1/2 inch portable self-contained emergency eye-wash fountain with twin criss-cross streams of water capable of constant flow for a minimum of 15 minutes. The fountain shall be manufactured of high-impact polyethylene and have a capacity of 16 gallons. The fountain shall be a "Porta-Stream II" as manufactured by Fend All of Arlington Heights Illinois or Owner approved equal.

L. Water Supply.....90 gallon tank minimum located inside the laboratory and equipped to be filled from outside. The water tank shall be clearly
marked "Non-Potable" inside the laboratory. The Contractor shall maintain an adequate supply of water in the tank as directed by the Owner.

M. Power Source.....115 volt, single phase AC, 650 watts.

N. Electrical Fixtures.....Two overhead light fixtures on one or two switches. The laboratory shall also be equipped with two outlets in the wall over the counter area and one outlet in the wall at each end of the laboratory.

O. Air Conditioner.....Two, 8500 BTU minimum air conditioners, installed in the windows and/or walls and spaced to provide adequate coverage of cool air throughout the Laboratory.

P. Sieve Shaker.....The sieve tester shall be a portable 8 inch sieve shaker with both back and forth lateral motion combined with up and down tilting motions. Overall dimensions shall be 30 inches high, 17 inches wide and 11 inches deep. The shaker shall have a timer with a hold feature and shall be equipped with a minimum of 1/4 h.p. motor, and the system shall be 115 volt, 60 Hz. The shaker shall be a Gilson Sieve Tester, Model SS-15, or approved equal with adequate safety features.

Q. Micro-Wave Oven.....The microwave oven shall be 115 volt, 60 Hz. manufactured by Magic Chef, Model No. MW 3172-4 or Owner approved equal. The oven shall have timer control and heat range control with three specific settings or variable range settings. The oven shall be a minimum volume of 1,600 cubic inches with minimum dimensions of 14 inches wide, 9 inches wide and 13 inches deep.

R. Heating.....Adequate for the size and type of unit furnished.

S. Vent Fan.....A vent fan for general ventilation shall be installed in the ceiling or wall directly above the hot plate area. The fan shall have a minimum capacity of 1,000 CFM, manufacturer’s rated capacity, and shall be equipped with a variable speed control.

T. Grill Requirements.....A 24 inch by 48 inch grill shall be installed in the hot plate area level with counter top, centered between the wall and the front edge of the counter top, designed to carry a minimum load of fifty pounds. A 1/4 inch by 14 inch by 30 inch steel plate shall be attached to the top of the grill, located 4 inches from the front edge of the grill and centered lengthwise on the grill. A 6 inch deep metal enclosure 24 inches by 48 inches shall be provided directly below the grill.

PART 3 - EXECUTION

3.1 GENERAL

A Type 1 Field Laboratory shall be furnished with the materials and to the dimensions specified in Part 2 above and installed at the location shown on the Drawings.

End of Section

2II-3
SECTION 2JJ - DESIGNATED HAUL ROAD MAINTENANCE

PART 1 - GENERAL

1.1 DESCRIPTION
The work in this section shall consist of all labor, material, and equipment and performing all operations required to be performed to maintain the Designated Haul Road as directed by the Owner.

1.2 QUALITY ASSURANCE
All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials shall conform to the latest standard specifications - ANSI, ASTM, AASHTO, AWS, etc.

PART 2 - PRODUCTS

2.1 CRUSHED AGGREGATE SURFACE COURSE
Crushed aggregate surface course shall meet the requirements of Section 2Q.

2.2 HOT PLANT MIX BITUMINOUS PAVEMENT
If the Owner determines that hot plant mix bituminous pavement is required under this section, it shall meet the requirements of the Wyoming Highway Department's "Specifications for Road and Bridge Construction".

PART 3 - EXECUTION

3.1 GENERAL
Prior to the use of the designated haul road, the Owner, Contractor, Engineer, and appropriate state and county officials shall conduct an inspection of the road to determine the condition of the existing road, drainage structures, and other appurtenances. The findings of this inspection shall be documented by the Owner and a copy of the report shall be sent to each participant of the inspection.

3.2 The Contractor shall maintain the designated haul road during each construction season under the Agreement in accordance with Section II.1.5 of the Specifications and as directed by the Owner.

3.3 The Contractor shall provide snow removal during each construction season under the Agreement on that portion of the designated haul road that is not plowed by either the Wyoming Highway Department, Natrona County, or Converse County on an as-needed basis as determined by the Owner.

3.4 Upon completion of the Contract, the Owner, Contractor, Engineer, and appropriate state and county officials shall again conduct an inspection of the road to determine the final restoration measures that shall leave

2JJ-1
the designated haul road in an equal or better condition than that found upon the initial inspection. The Owner shall furnish written instructions to the Contractor for final restoration measures. The final payment shall not be processed until this restoration work has been acceptably completed.

3.5 Any damage to the designated haul road that is caused by the Contractor exceeding the legal load limits shall be repaired as directed by the Owner, at no cost to the Owner.

End of Section
A. **General.** Work shall include furnishing all materials, labor, equipment, and incidentals necessary for construction of this item. The underdrain shall be constructed in accordance with these specifications and in conformity with the lines and grades shown on the Drawings or established in the field by the Owner.

B. Related Work Described Elsewhere.....Concrete Division 3.

### 1.2 QUALITY ASSURANCE

A. Manufacturers.....All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials shall conform to the latest standard specifications--ANSI, ASTM, AWS, etc. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern. The work in this section shall be performed by experienced craftsmen, well-versed and (where applicable) certified in the grades involved, and under the direction of competent supervisors to ensure proper and adequate installation of these materials.

B. Source.....All items for the underdrain piping system shall be furnished and coordinated by one fabricator or manufacturer.

### 1.3 SHOP DRAWINGS

A. Shop Drawings.....Before any underdrain pipe materials are delivered to the site, shop drawings must be submitted in accordance with the General Requirements, Part 1.D and must be approved by the Owner. Shop drawings shall include all dimensions, details, special sections, splicing, layout, and installation procedures.

B. Proof of Compliance.....Contractor shall deliver to Owner a letter certifying the material furnished complies with the requirements of these specifications.

### 1.4 PRODUCT HANDLING

A. Protection.....All means necessary shall be used to protect the materials before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements shall be made to the approval of the Owner and at no additional cost to the Owner.
PART 2 - PRODUCTS

2.1 UNDERDRAIN PIPE AND FITTINGS

A. General....Drains shall be constructed at the locations shown on the Drawings or as directed by the Owner. Care shall be taken to avoid clogging the drains during the progress of the work, and should any drain become clogged or obstructed from any cause before final acceptance of the work, it shall be cleaned out in a manner approved by the Owner or replaced by and at the expense of the Contractor. No pipe which has been damaged shall be used in the work if, in the opinion of the Owner, the pipe is unfit for use.

B. Underdrain Pipe.....The upper plunge pool underdrain pipe shall be perforated 6-inch PVC pipe. The pipe and fittings shall be PVC Schedule 40 in accordance with ASTM D 1785 and shall have bell and spigot ends. The pipe shall be perforated in accordance with perforation dimensions presented in ASTM D 2729 (two rows of holes 1/2-inch in diameter on 5-inch centers, and the rows shall be parallel to axis of the pipe and 120 degrees apart).

C. Bedding Material.....The bedding material adjacent to the pipe as shown on the Drawings shall consist of 1" concrete aggregate, as approved by the Owner. The bedding material shall be obtained from approved sources of coarse aggregate for concrete or may be produced by screening the desired size from selected material from required spillway excavation or from borrow pits in the area.

D. Screen.....Pipe-end screens shall be No. 4 galvanized steel mesh.

PART 3 - EXECUTION

3.1 GENERAL

The upper plunge pool underdrain piping shall be constructed at the locations and alignments shown on the Drawings. The PVC pipe and fittings shall be the standard commercial product of one manufacturer.

3.2 INSTALLATION

The pipe placement locations shall be excavated in accordance with the Drawings to allow required bedding placement.

The perforated pipe shall be embedded in crushed rock bedding as shown on the Drawings and specified above.

The methods of placing pipe in position shall be such as to prevent getting dirt inside of the pipe and coupling and to prevent damage to the pipe. Before and during assembly of a joint, all parts shall be clean and shall be free of mud, ice, oil, or grease. All joints shall be made in accordance with the manufacturer's recommendations.

The perforated pipe shall be laid carefully in the bedding material with the perforations symmetrical about the vertical centerline and below the
horizontal centerline. The pipe shall then be covered with the additional minimum thickness of bedding materials as shown on the Drawings. The bedding materials shall be placed and tamped about the pipe so as not to disturb the pipe and to hold it securely in position while the overlying material is being placed. The bedding material shall be overlaid in its entirety with burlap prior to concrete placement of the upper plunge pool floor slab.

The pipe ends shall be 90-degree elbow fittings turned upwards with an attached riser of sufficient length to be flush with finished concrete surface of upper plunge pool floor slab. A galvanized screen shall be securely fastened to all risers to allow casting-in-place of the riser with the attached screen. Pipe end locations shall be as shown on the Drawings.

End of Section
SECTION 3A - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....Design and construct the forms for all cast-in-place concrete indicated on the drawings and subsequently remove all such forms.

B. Related Work Described Elsewhere -

1. Earthwork For Structures
2. Concrete Reinforcement

1.2 QUALITY ASSURANCE

A. Qualifications Of Workmen.....Provide at least 1 person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this work, and who shall direct all work performed under this section.

B. Codes And Standards -

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Recommended Practice For Concrete Formwork", Publication ACI 347 of the American Concrete Institute.

2. Where provisions of pertinent codes and standards conflict with the requirements of this section of these specifications, the more stringent provisions shall govern.

1.3 SHOP DRAWINGS

Prior to beginning any formwork, the Contractor shall submit complete plans and description of the placing methods proposed to be used.Plans shall indicate all construction joint locations for acceptance by Owner.

1.4 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect formwork materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.
PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Form Lumber. All form lumber in contact with exposed concrete shall be new except as allowed for re-use of forms in Part 3 of this section of these Specifications, and all form lumber shall be 1 of the following, a combination thereof, or an equal approved in advance by the Owner:


2. Douglas Fir-Larch, Number 2 Grade, seasoned, surfaced 4 sides.

B. Form Sealers. All form sealers shall be first quality of their respective kinds and subject to the approval of the Owner.

2.2 TIES AND SPREADERS

A. Type. All form ties shall be a type which does not leave an open hole through the concrete and which permits neat and solid patching at every hole.

B. Design. When forms are removed, all metal shall be not less than 1 inch from the surface.

C. Wire Ties And Wood Spreaders. Do not use wire ties and wood spreaders.

2.3 ALTERNATE FORMING SYSTEMS

A. Alternate forming systems may be used subject to the advance approval of the Owner.

2.4 OTHER MATERIALS

A. All other materials, not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to the advance approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that forms may be constructed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.
B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 DESIGN AND CONSTRUCTION OF FORMS

A. General....Design and construct all required forms to be substantial, sufficiently tight to prevent leakage of mortar, and able to withstand excessive deflection when filled with wet concrete. Design loads and pressures shall conform to those stipulated in "Recommended Practice For Concrete Formwork", American Concrete Institute Publication ACI-347.

B. Layout -

1. Form for all required cast-in-place concrete to the shapes, sizes, lines, and dimensions indicated on the Drawings.

2. Exercise particular care in the layout of forms to avoid necessity for cutting of concrete after it is in place.

3. Make proper provision for all openings, offsets, recesses, anchorage, blocking, and other features of the work as shown or required.

4. Perform all forming required for work of other trades and do all cutting and repairing of forms required to permit such installation. Sleeves, thimbles, and blockouts shall be furnished by each trade requiring same. Subcontractor shall be responsible for assisting General Contractor in locating positions of above inserts.

5. Carefully examine the Drawings and Specifications and consult with other trades as required relative to provision for openings, reglets, chases, and other items in the forms.

c. Embedded Items.....Set all required reinforcement, steel frames, angles, grilles, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed.

D. Bracing -

1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.

2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.

3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tieing and accurate spreading.

E. Tolerances.....Construct all forms straight, true, plumb, and square within a tolerance horizontally of 1 in 400 and a tolerance vertically of 1 in 500.

3A-3
F. Wetting. Keep forms sufficiently wetted to prevent joints opening up before concrete is placed.

3.3 FORMS

A. Design. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.

B. Joints. Make all panel joints tight butt joints with all edges true and square.

C. Corners. Unless otherwise shown on the plans, corners measuring less than 120°, that will be exposed in the finished structure, shall be chamfered with a carefully fitted 3/4 inch triangular chamfer strip.

3.4 FOOTING FORMS

A. Wood Forms. All footing forms shall be wood unless otherwise specifically approved by the Owner.

B. Earth Forms -

1. Upon approval of the Owner, side forms for footings may be of earth provided the soil will stand without caving in and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings.

2. Make all necessary provisions to prevent cave-ins during placement of concrete.

3.5 RE-USE OF FORMS

A. General. Re-use of forms shall be subject to advance approval of the Owner.

B. Requirements -

1. Except as specifically approved in advance by the Owner, re-use of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.

2. Except as specifically approved in advance by the Owner, re-use of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.
3.6 REMOVAL OF FORMS

----------
A. General -

1. In general, side forms of footings and foundations may be removed 24 hours after placement of concrete, but the time may be extended if deemed necessary.

2. Do not remove forms until the Owner's approval has been obtained.

B. Removal -

1. Use all means necessary to protect workmen, passersby, the installed work and materials of other trades, and the complete safety of the structure.

2. Cut nails and tie wires or form ties off flush, and leave all surfaces smooth and clean.

3. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.

4. Flush all holes resulting from the use of the spreader rods and sleeve nuts, using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be 1 part portland cement to 2-1/2 parts sand: apply grout immediately after removing forms.

End Of Section
SECTION 3B - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....Furnish and install all reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete.

1.2 QUALITY ASSURANCE

A. Qualifications Of Workmen.....Provide at least 1 person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all work performed under this section.

B. Codes And Standards -

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Manual Of Standard Practice For Detailing Reinforced Concrete Structures", Publication ACI 315 of the American Concrete Institute, and "Recommended Practice For Placing Reinforcing Bars", of the Concrete Reinforcing Steel Institute.

2. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.

1.3 SHOP DRAWINGS

A. Before any concrete reinforcement materials are delivered to the job site, submit shop drawings to the Owner in accordance with the General Requirements, Section 1.D, of these Specifications. Submittals shall indicate bending diagrams; assembly diagrams; splicing and laps of rebar; shapes; dimensions and details of bar reinforcing and accessories.

1. Do not deliver concrete reinforcement to the job site until receipt of Owner approved shop drawings.

B. Proof of compliance.....deliver to the Owner a letter certifying that the material furnished complies with the requirements of these Specifications.

3B-1
1.4 PRODUCT HANDLING

A. Protection -

1. Use all means necessary to protect concrete reinforcement before, during, and after installation and to protect the installed work and materials of all other trades.

2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

3. Use all necessary precautions to maintain identification after the bundles are broken.

B. Replacements....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CONCRETE REINFORCEMENT

A. All concrete reinforcement materials shall be new, free from rust, and complying with the following reference standards:

1. Bars For Reinforcement...."Specifications For Deformed Billet-Steel Bars For Concrete Reinforcement", ASTM A615, Grade 60.

2. Wire For Reinforcement....."Specifications For Cold-Drawn Steel Wire For Concrete Reinforcement", ASTM A82.


2.2 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of concrete reinforcement, shall be as selected by the Contractor subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to installation of the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations, the approved shop drawings and the original design.
B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 BENDING

A. General

1. Fabricate all reinforcement in strict accordance with the approved shop drawings.

2. Do not use bars with kinks or bends not shown on the drawings or on the approved shop drawings.

3. Do not bend or straighten steel in a manner that will injure the material.

B. Design -

1. Bend all bars cold.

2. Make bends for stirrups and ties around a pin having a diameter not less than 4 times the minimum thickness of the bar.

3. Make bends for other bars, including hooks, around a pin having a diameter not less than 6 times the minimum thickness of the bar for bars up to 1 inch in diameter and 8 times the minimum thickness of the bar for bars over 1 inch in diameter.

3.3 PLACING

A. General.....Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting with metal chairs or spacers, or metal hangers.

B. Clearance -

1. Preserve clear space between bars of not less than the normal diameter of round bars.

2. In no case let the clear distance be less than 1 inch nor less than 1-1/3 times the maximum size of aggregate.

3. Provide the following minimum concrete covering of reinforcement:

   a. Concrete below ground deposited against forms: 2 inches.

   b. Concrete deposited against earth: 3 inches.
c. Concrete elsewhere: as indicated on the drawings or otherwise approved by the owner.

C. Splicing –

1. Horizontal Bars –
   a. Place bars in horizontal members with minimum laps at splices sufficient to develop the strength of the bars.
   b. Bars may be wired together at laps except at points of support of the member, at which points preserve the clear space described above.
   c. Wherever possible, stagger the splices of adjacent bars.
   d. Splice bars as shown on Drawings (Structural, General Notes).

2. Wire Fabric.....Make all splices in wire fabric at least 1 1/2 meshes wide.

3. Other Splices.....Make only those other splices that are indicated on the approved shop drawings or specifically approved by the Owner. Welded splices will not be used unless specifically approved by the Owner.

4. Corner Bars.....All corners and intersections of footings, walls or foundations shall have lapped splices of longitudinal rebar, or corner bars providing lapped splices, as shown on Drawings (Structural, General Notes).

D. Dowels.....Place all required steel dowels and securely anchor them into position before the concrete is placed.

E. Obstructions.....In the event conduits, piping, inserts, sleeves, or any other items interfere with placing reinforcement as indicated on the Drawings or as otherwise required, immediately consult the Owner and obtain approval of new procedure before placing concrete.

3.5 CLEANING REINFORCEMENT

A. Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil, paint, and all other coatings which will destroy or reduce bond between steel and concrete.

3.6 ADDITIONAL REINFORCEMENT

A. The Contractor shall furnish loose, to the job site, 50 lineal feet per 1000 lineal feet each of each rebar required for use during construction.

End Of Section
SECTION 3C - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....Cast-in-place concrete required for this work is indicated on the Drawings and includes, but is not necessarily limited to:

1. Footings and foundations.
2. Slabs on grade.
3. Structural slabs.
4. Walls.
5. Tunnel lining.
7. Beams and columns.
8. Gaging station control structures and associated facilities.
9. Concrete boat ramp.

B. Related Work Described Elsewhere -

1. Rules Governing Tests And Inspection.
2. Earthwork For Structures.
3. Concrete Form Work.
4. Concrete Reinforcement.
5. Concrete Appurtenances.

1.2 QUALITY ASSURANCE

A. Qualifications Of Workmen -

1. Provide at least 1 person who shall be present at all times during execution of this portion of the work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this section.

2. For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
B. Codes And Standards –

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations of "Structural Concrete For Buildings", Publication ACI 301 of the American Concrete Institute and "Recommended Practice For Measuring, Mixing, Transporting, And Placing Concrete" Publication ACI 304-73 of the American Concrete Institute.

2. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.

3. Contractor shall have available at project field office a copy of ACI Sp-15 "Specifications For Structural Concrete For Buildings With Selected ACI And ASTM References".

1.3 SHOP DRAWINGS

A. Batch Plant.....Before any concrete is delivered or paid for submit description and certification that batch plant meets the requirements of ASTM C94. Batch plant shall be equipped with automatic recording devices to record all material quantities used in each batch produced. If a transit mix concrete supplier is used, provide the name and address of the transit mix concrete supplier for approval.

B. Materials List.....Before any concrete is delivered to the job site, submit to the Owner in accordance with the General Requirements of these Specifications a complete list of; certificate of material compliance of; or test results of all materials proposed to be furnished and installed under this portion of the work, showing manufacturer’s name and catalog number of all items such as admixtures and curing compound.

C. Concrete Mix Design.....Before any concrete is delivered, furnish to the Owner, for acceptance, a concrete mix design for each class of concrete to be used. The design mix shall be proven by compression test cylinders, tested by a recognized testing laboratory, or by certification and test results of a standard mix of the transit-mix concrete supplier. All material used in the design mixes shall be that proposed for this project. Tests shall be in accordance with "Method Of Test For Compressive Strength Of Molded Concrete Cylinders" (ASTM C39). The slump of the concrete used in these test cylinders shall not be less than the maximum slump specified. No payment for concrete will be made until design mixes have been accepted by Owner.

D. Transit-Mix Delivery Slips –

1. Keep a record at the job site showing time and location of each placement of concrete, together with transit-mix delivery slip certifying contents of the pour as per ASTM C94, Sections 15.1 and 15.2.

2. Make the record available to the Owner for his inspection upon request.

3. Upon completion of this portion of the work, deliver the record and the delivery slips to the Owner.
1.4 PRODUCT HANDLING

A. Protection....Use all means necessary to protect cast-in-place concrete materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 CONCRETE

A. General -

1. All concrete, unless otherwise specifically permitted by the Owner, shall be transit-mixed in accordance with ASTM C94.

2. The control of concrete production and all tests of cement, aggregates, and water shall be by a recognized testing laboratory, approved by and at the expense of the Owner.

B. Quality -

1. All classes of concrete shall have the following minimum compressive strength at 28 days and shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Class</th>
<th>Min. Comp. Strength (P.S.I.)</th>
<th>Percent Air By Volume</th>
<th>Max. Slump (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4000</td>
<td>4 to 7</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>3000</td>
<td>4 to 7</td>
<td>4</td>
</tr>
</tbody>
</table>

2. All concrete shall be air entrained.

C. Cement.....All cement shall be Portland Cement conforming to ASTM C-150, Type II, and shall be the product of one manufacturer; the temperature of cement delivered to the plant shall not exceed 150 degrees F. Certification of each delivery shall be furnished to Owner.

D. Aggregates -

1. All aggregates shall conform to ASTM C33.

2. Stockpiles shall be built up in layers of not more than three feet in thickness. Each layer shall be completely in place before the next is begun, and layers shall not be allowed to "cone" down over lower layers. Aggregates from different sources and of different gradings shall not be stockpiled together.
3. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used.

4. Coarse Aggregates -

Nominal aggregate size shall be in accordance with ASTM C33 size numbers 467, 57, or 67. Beams, columns, and sections 8" or less in thickness shall be placed with aggregate size 67. All other concrete may be placed with aggregate size 467 or 57. Certified test results shall be submitted which demonstrate that the proposed aggregates are non-reactive when tested in accordance with ASTM C227.

E. Water......All water shall be potable, clear, clean, and free from smell, taste, or deleterious matter. Water of questionable quality shall be subject to the acceptance criteria of ASTM C-94, Table 1.

F. Admixture.....All concrete shall contain an air-entraining admixture conforming to ASTM C260.

2.3 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of cast-in-place concrete, shall be as selected by the Contractor subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Contractor shall verify that all items to be embedded in concrete are in place.

3. Contractor shall verify that concrete may be placed to the lines and elevations indicated on the drawings, with all required clearance from reinforcement.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3.2 PREPARATION

A. General -

1. Remove all wood scraps and debris from the areas in which concrete will be placed.

2. Thoroughly clean the areas to ensure proper placement and bonding of concrete.

3. Thoroughly wet the forms (except in freezing weather), or oil them; remove all standing water.

4. Thoroughly clean all transporting and handling equipment.

B. Notification.....Notify the Owner at least 24 hours before placing concrete. Concrete shall not be placed until all forms and reinforcing have been inspected and approved by the Owner.

3.3 PLACING CONCRETE

A. Conform to ACI-304, "Recommended Practice For Measuring, Mixing, And Placing Concrete".

B. Method -

1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials.

2. For chuting, pumping, and pneumatically conveying concrete, use only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials.

3. Deposit concrete as nearly as possible in its final position to avoid segregation due to rehandling and flowing.

4. Place concrete as dry as possible consistent with good workmanship, never exceeding the maximum specified slump.

5. Place concrete in a manner that will avoid splashing forms or reinforcing bars and shall not be dropped freely more than 4 feet.

6. Aluminum pump lines or tools will not be allowed during concrete pumping, placement, or finishing.

7. When placing concrete on incline, begin placement at bottom of incline and proceed up slope.

C. Rate Of Placement -

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between bare bars.
2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete.

3. Do not pour a greater area at one time than can be properly finished without checking; this is particularly important during hot or dry weather.

4. When stoppage of concreting operations occurs for any reason, construction joints shall be placed as required. Construction joints shall be provided with shear key, and/or dowels, to resist shear and moment as approved by the Owner.

D. Compaction -

1. Thoroughly consolidate all concrete by suitable means during placement, working it around all embedded fixtures and into corners of forms.

2. During placement, thoroughly compact the concrete by mechanical vibration. Vibrate sufficiently only to bring a continuous film of mortar to the surface. Vibration will stop before any segregation of the concrete occurs.

E. Acceptability......Deliver to the job site batches of concrete kept as uniform as possible in consistency and strength. The following would be considered a basis for the rejection of the concrete delivered to the site.

1. Evidence that the concrete has been retempered.

2. Concrete that has been contaminated with foreign material.

3. Slump exceeding maximum specified.

4. Percent of entrained air not within specified limits.

5. Discharge from truck not within the 1 1/2 hour limitation of ASTM C94.

3.4 CONSTRUCTION JOINTS

A. Location.....Make and locate construction joints so as to not impair the strength of the structure. All construction joints shall be sand blasted to remove all laitance, washed completely, and surface dried.

B. Approval.....Obtain the Owner's approval of preparation and location of all construction joints and control joints in the work prior to start of concrete placement.

3.5 FINISHING

A. All surfaces shall be finished to the following requirements:
<table>
<thead>
<tr>
<th>Structure</th>
<th>Surface</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spillway:</td>
<td>Bridge deck and curbs</td>
<td>Light broom</td>
</tr>
<tr>
<td></td>
<td>Bridge girders</td>
<td>Formed</td>
</tr>
<tr>
<td></td>
<td>Bridge piers</td>
<td>Formed</td>
</tr>
<tr>
<td></td>
<td>Crest</td>
<td>smooth trowel (un-formed surfaces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rubbed (formed surfaces)</td>
</tr>
<tr>
<td></td>
<td>Approach apron</td>
<td>Smooth trowel</td>
</tr>
<tr>
<td></td>
<td>Slope paving</td>
<td>Formed or slip formed</td>
</tr>
<tr>
<td></td>
<td>Upper Plunge Pool floor</td>
<td>Smooth trowel</td>
</tr>
<tr>
<td>Intake Structure:</td>
<td>Top slab</td>
<td>Light broom</td>
</tr>
<tr>
<td></td>
<td>Beams and columns</td>
<td>Formed</td>
</tr>
<tr>
<td></td>
<td>Top of bulkhead</td>
<td>Light broom</td>
</tr>
<tr>
<td></td>
<td>Sill slab</td>
<td>Light broom</td>
</tr>
<tr>
<td>Control Building:</td>
<td>Roof</td>
<td>As required by roofer</td>
</tr>
<tr>
<td></td>
<td>Exposed exterior walls</td>
<td>Sack</td>
</tr>
<tr>
<td></td>
<td>Floors</td>
<td>Light broom</td>
</tr>
<tr>
<td></td>
<td>Interior ceiling and beams</td>
<td>Formed</td>
</tr>
<tr>
<td></td>
<td>Retaining wall - exposed faces</td>
<td>Sack</td>
</tr>
<tr>
<td>Face Of Dam:</td>
<td>Slab</td>
<td>Slip formed</td>
</tr>
<tr>
<td></td>
<td>Retaining wall - exposed faces</td>
<td>Sack</td>
</tr>
<tr>
<td></td>
<td>Plinth</td>
<td>Metal or wood float</td>
</tr>
<tr>
<td>Boat Ramp:</td>
<td>Boat ramp slab</td>
<td>Metal tine</td>
</tr>
</tbody>
</table>

3C-7
B. General -

1. Tamp slabs with a vibrator to consolidate the concrete, and then push-float with a bullfloat as necessary.

2. Take care that the wet slab meets the screeds accurately and does not rise above or lower below them.

C. Finishing slabs -

1. Unless otherwise indicated on the Drawings, make all slabs even and uniform in appearance and, where no slope is required, level within plus or minus 1/8 inch in 10 feet.

2. Where floor slopes are indicated, slope slabs uniformly to provide even fall for drainage. Gradual irregularities in slope shall not exceed 1/4 inch in 10 feet.

3. Dusting of finished surfaces with dry materials or additions of water to concrete surfaces will not be permitted.

4. Metal Tine....Immediately following the bullfloat finish, the surface of the plastic concrete boat ramp shall be given a transverse metal tine finish. The time of application of the finish and method of operation shall be controlled so as to minimize the tearing of the surface and unseating of aggregate particles. The device used for obtaining the metal tine finish shall be equipped with 4-inch to 6-inch steel tines approximately 1/32 inch in thickness and 3/32 inch in width at 1/2-inch centers. The grooves produced in the concrete shall be 1/8 inch to 3/16 inch in depth. The grooved finish shall be at right angles to the centerline of the boat ramp. The metal tine device shall be operated by approved mechanical or manual means. Care shall be taken to avoid overlaps of the passes in the metal tine operation. Texturing equipment, other than the tine device, may be approved by the Owner, provided it produces a texture equivalent to that produced by the metal tine.

D. Light Broom.....After concrete has been screeded to grade, it shall be floated with a metal or wooden float followed by a steel trowel finish. When concrete is sufficiently hard to retain scoring, the surface shall be brushed with a soft bristled broom.

E. Slip Formed.....Additional finishing will not be required as long as surface finish is equal to finish obtained if forms had been used.

F. Smooth Trowel.....After concrete has been screeded to grade, it shall be floated with a metal or wooden float followed by a steel trowel finish.

G. Finishing, Exposed Concrete Other Than Slabs -

1. Remove all fins and loose materials.
2. Patch all honeycomb, voids, and other imperfections.

3. Give smooth, uniform finish to all concrete surfaces.

4. Keep all areas damp during finishing operations.

H. Sack.....Apply a "sack" finish by coating the concrete with a mixture of 1 part fine sand to 1 part cement and enough water to provide a creamy consistency, using rough burlap sacking for application, and achieving a uniformly textured surface.

I. Formed.....Allowable formwork deviation from plumb or level is specified in Section 3A under "tolerances".Abrupt or gradual irregularities over a 5' length shall not exceed 1/4".

3.6 CURING

A. General -

1. Cure all concrete, regardless of temperature, weather, or season, to protect it from premature drying or loss of moisture.

2. Immediately upon finishing a slab area or removing formwork from vertical surfaces, curing procedures shall be initiated.

B. Optional Curing Methods -

1. For Mist Cure -

   a. Immediately upon finishing an area, apply a fog mist above the finished concrete surface, using a fog nozzle of a type approved by the Owner, to keep the air humid and to prevent loss of moisture from concrete.

   b. Produce an appearance of wet sheen on the concrete but do not permit puddling of the water.

   c. Continue fogging for 10 days or until another curing medium is used.

2. Membrane Cure -

   a. Immediately upon finishing an area, apply an Owner approved curing membrane.

   b. Lap and securely join all joints.

   c. Weight membrane down to prevent wind damage.

   d. Keep membrane in place and intact for at least 10 days after concrete placement.
3. Curing Compound -
   a. Immediately upon finishing an area, apply an Owner approved curing compound to the entire area.
   b. Apply in strict conformance to the recommendation of the manufacturer.
   c. Allow no traffic on slabs for 24 hours and minimal traffic on slabs for 10 days after concrete placement.

4. Other curing methods will be used only with the approval of the Owner.

3.7 TESTING

A. General.... all concrete shall be tested by and at the expense of the Owner.

B. Compression Strength Test -
   1. Shall conform to ASTM C39 "Method Of Test For Compressive Strength Of Molded Concrete Cylinders".
   2. Minimum of three (3) standard cylinders shall be molded and tested for each pour where 100 cubic yards, or any fraction thereof, is placed in any one day.
   3. Minimum of three (3) additional cylinders shall be molded and tested for each additional 100 cubic yards, or fraction thereof, placed in the same day.
   4. Additional cylinders to be molded, under adverse conditions, as required by the Owner.

C. Slump Test -
   1. Shall conform to ASTM C143 "Method Of Test For Slump Of Portland Cement Concrete".
   2. Test to be taken as directed by the Owner.

D. Air Content -
   1. Shall conform to ASTM C143 "Method Of Test For Slump Of Portland Cement Concrete".
   2. Test to be taken as directed by Owner.

3.8 HOT WEATHER REQUIREMENTS

A. General....shall be in accordance with recommended practice for Hot Weather Concreting (ACI-605).
B. Placement -

1. Do not use concrete with a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints.

2. Maintain a concrete temperature during placement of less than 90 degrees F (32 degrees C).

3. Use all means necessary to avoid drying the concrete prior to finishing operations.

C. Protection - Provide and use all required windbreaks, sunshades, fog sprays, and other devices to protect the concrete.

3.9 COLD WEATHER REQUIREMENTS

A. General - shall be in accordance with "Recommended Practice For Cold Weather Concreting" (ACI-306).

B. Placement -

1. Place concrete with the mix temperature between 50 degrees F (10 degrees C) and 100 degrees F (38 degrees C).

2. When concrete is placed at air temperatures at or below 40 degrees F (4 degrees C), protection will be provided.

3. Concrete will not be placed against or on frozen material.

C. Protection -

1. Provide and use all required framework, cover, heating apparatus, and other devices to protect the concrete.

2. Protect concrete and/or aggregates during batching, transit, and mixing and before and after placing.

3. Provide protection of the concrete to maintain the temperature of the mix at not less than 50 degrees F (10 degrees C) until at least sixty percent (60%) of the design strength has been attained.

3.10 DEFECTIVE WORK

A. Inspection -

1. Immediately after forms have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holes, and other imperfections before the concrete is thoroughly dry. No deviation from above instructions will be allowed.

2. Do not patch until concrete has been inspected by the Owner.
B. Patching -

1. Minor Defective Areas -
   
a. Chip away to a depth of about 1 inch, leaving edges perpendicular to the surface; wet the area to be patched and a space of at least 6 inches wide around it to prevent water being absorbed out of the mortar.

b. Apply "Proweld-D bonding agent" as manufactured by Protex Industries Inc., on the area to be patched. Apply the patching mortar after bond becomes tacky.

c. Patching mortar shall consist of 1 part cement to 3 parts sand, with bonding agent added, to a consistency as dry as possible within the requirements of handling and placing; thoroughly compact the mortar by ramming it into place.

d. Screed off so as to leave the patch slightly higher than surrounding surfaces; leave undisturbed for a period of 1 to 2 hours to permit initial shrinkage, and then perform final finishing.

e. Finish the patch to match adjacent surfaces and keep wet for at least 7 days; provide and install all required protective covering.

2. Major Defective Areas.....If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Owner may require the concrete be removed and replaced complete in accordance with the provisions of this section, all at no additional cost to the Owner. If patching is required, use "set vertipatch" with bonding agent and apply in strict conformance with the recommendations of the manufacturer.

End Of Section
SECTION 3D - CONCRETE APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....All miscellaneous items not specifically described in other sections of these Specifications but required for a complete and operable facility.

B. Related Work Described Elsewhere -

1. Cast-In-Place Concrete.

2. Miscellaneous Metal.

1.2 QUALITY ASSURANCE

A. Qualification Of Fabricators Or Suppliers.....All manufacturers, suppliers, and/or fabricators shall be acceptable firms and shall have not less than 5 years of continuous experience in the production of the specified item.

B. Qualification Of Installers.....A competent superintendent with experience in total job coordination shall be in charge of work at all times.

1.3 SHOP DRAWINGS

A. Shop Drawings.....For those items requiring coordination with other trades, such as metal inserts, dowels, and other embedded items, complete shop drawings shall be submitted in accordance with the General Requirements, Section 1D to the Owner, before any of these items are delivered to the job site.

B. Materials List.....Before any items are delivered to the job site, submit a list of all materials and material compliance certification to be furnished under this portion of the work, giving manufacturer’s name, catalog number, and catalog cut for each item where applicable.

C. Manufacturer’s Recommendations.....Submit copies of the manufacturer’s current recommended method of installation for those specialty items that require special methods of application or installation.

1.4 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect the materials of this section before, during, and after installation and to protect the installed work and materials of all other trades.
B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 MISCELLANEOUS APPURTENANCES

A. General....All miscellaneous concrete appurtenances shall be new, conforming to these specifications, installed, applied, or fabricated in complete accordance with the manufacturer's recommendations, and coordinated with all other work.

B. Concrete Admixtures -

1. Air Entraining Admixture.....shall conform to "Specifications For Air-Entraining Admixtures For Concrete" (ASTM C 260).

2. Water Reducing Agent.....shall be used only with the approval of the Owner. If approved, water reducing agent shall conform to "Specifications For Chemical Admixtures For Concrete" (ASTM C 494) and may be Master Builder's "Pozzolith" or Protex "PDA" used in strict conformance with manufacturer’s recommendations.

3. Pozzolan.....Pozzolan (fly ash) shall conform to the requirements of ASTM Standard C618, Class F or Class C, including the Supplemental Optional Chemical Requirements for available alkalis and the Supplemental Optional Physical Requirements for uniformity and reactivity with cement alkalis. Maximum loss on ignition shall not be over 4 percent. Samples shall be obtained, prepared, and tested in accordance with ASTM C311. Only one class of fly ash from a single source may be used.

4. Other Admixtures.....No other admixtures shall be used without approval of Owner.

C. Curing Compounds.....shall be colored and shall conform to Federal Specification TT-C-00800 Type I and ASTM C 309 "Specification For Liquid Membrane-Forming Compounds For Curing Concrete". Manufacturer’s application recommendations shall be strictly adhered to. Compound shall be completely compatible with all coatings and coverings to be applied to the concrete.

D. Curing Membrane.....shall be 6-mil weight sheet plastic, in sheets as wide as possible to avoid joints, a combination sheet plastic and paper, or an equal approved in advance by the Owner.

E. Grout.....shall be non-shrink, non-metallic, flowable or dry pack grout and shall be Master Builder’s "Masterflow 713 Grout", or Protex "Propak" or approved equal. Metallic grout such as Master Builder’s "Embeco" shall be used only where covered by earth, concrete or masonry. Approval required before using and shall be used in strict conformance with manufacturer’s recommendation.
F. Expansion Joint Filler.....shall be premolded expansion joint filler and shall conform to "Specifications For Performed Expansion Joint Filler For Concrete (Bituminous Type)" ASTM D 994.

G. Dowels.....shall be smooth round bars conforming to "Specifications For Carbon Steel Bars Subject To Mechanical Property Requirements" (ASTM A 306 - Grade 45).

H. Anchor Bolts.....shall be new, free from rust, and conforming to the requirements of ASTM A 307.

I. Stud Anchors.....Stud anchors shall be of the size and shape shown on the Drawings and shall be flux filled for end welding with automatic end welding guns.

J. Expansion Anchors.....Expansion anchors shall be double wedge expansion type anchors as manufactured by Wej-it Expansion Products, Inc., of Broomfield, Colorado, or approved equal. Sizes and type shall be as indicated on the Drawings. Anchors shall have the accredited pullout and shear values as published by Wej-it.

K. Miscellaneous Anchors.....Bolts, toggles, and other miscellaneous anchoring devices shall be of the type and sizes indicated on the drawings.

L. Embedded Metal Plate Assemblies.....shall conform to the requirements of Section 5B "Miscellaneous Metals" of these Specifications.

M. Moldable Waterstop.....shall be manufactured from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes, or obnoxious odors. Moldable waterstop shall be protected by a removable 2-piece wrapper to facilitate application and be supplied in suitable cross section and size to seal the joint area of the section. Moldable waterstop shall be equal to Synko-Flex preformed plastic waterstop as manufactured by Synko-Flex Products Company or an Owner approved equal.

N. Waterstop.....Waterstop shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed materials. Waterstop shall be 9-inch dumbell type with center bulb. Waterstop shall be equal to Progress Unlimited, Inc. Waterstop "X" as manufactured by Progress Unlimited, Inc., or an Owner approved equal.

O. Sealant.....shall be Dow Corning 790 building sealant as manufactured by Chemical Products Division, Dow Corning Corporation.

P. Evaporation Retardant.....Evaporation retardant and finishing aid shall be Master Builder's "Confilm" or an Owner approved equal.

Q. Fiber Reinforcement.....Reinforcing fibers shall be 100% polypropylene olefin collated fibers, manufactured by Fibermesh Company. Fiber length will be determined by the manufacturer to correspond with the concrete mix design. The fiber manufacturer shall provide the services of a
qualified employee for a pre-job meeting, and initial job start up. The fiber manufacturer shall certify in writing that all polypropylene fibers are specifically manufactured for use in concrete from virgin polypropylene.

R. Stainless Steel Waterstop.....Stainless steel waterstop shall be fabricated from stainless steel sheet or strip, 20 gage, Type 304, Grade A, No. 2D finish, ASTM A666, latest edition. Waterstop shall be fabricated to the dimensions shown on the contract drawings.

S. Neoprene Filler.....Neoprene filler shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed materials. Filler shall be extruded to the shape of the stainless steel waterstop-center web.

2.2 OTHER MATERIALS

A. All other materials, not specifically described but required for complete and proper installation, shall be new, first quality of their respective kinds, and subject to approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that all miscellaneous concrete appurtenances may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. General.....Install all miscellaneous concrete appurtenances in strict accordance with the manufacturer's recommendations, as approved by the Owner.
B. Curing Membrane -

1. Cure all interior slabs by fog mist until curing membrane has been installed.

2. Install membrane as stipulated under Section 3C "Cast-In-Place Concrete".

C. Expansion Joint Filler -

1. Joint filler shall be of the sizes shown, and installed at the locations detailed, on the Drawings.

2. Joint filler shall be installed with tight contact, on both sides of joint, with all gravel and debris removed.

D. Stainless Steel Waterstop -

Stainless steel waterstop shall be welded by workmen experienced in welding stainless steel. Welding shall be as recommended by American Welding Society AWS D10.4 or as approved by Owner. Electrodes shall be series E308.

End Of Section
SECTION 3E - SHOTCRETE

PART 1 - GENERAL

1.1 EXTENT OF WORK

The work covered in this section of the Specifications includes the requirements for materials, proportioning mixes, preparing test panels, and applying shotcrete to cover rock excavations as shown on the Drawings or where required and accepted by the Owner in permanent open cut excavations and the tunnel and shaft. Applications of shotcrete in the permanent excavations, tunnels, and shaft at locations other than those shown on the Drawings shall be paid for only where required and accepted by the Owner.

1.2 DEFINITIONS

A. Blow Pipe.....Air jet operated by nozzleman's helper in shotcrete gunning to keep rebound or other loose materials out of the work.

B. Natural Gun Finish.....Undisturbed final layer of shotcrete as applied from nozzle without hand finishing.

C. Nozzle.....Attachment at end of shotcrete material hose from which material is jetted at high velocity.

D. Nozzleman.....Workman on a shotcrete crew who manipulates the nozzle, controls consistency and makes final disposition of the material.

E. Rebound.....Aggregate and cement or wet shotcrete which bounces away from a surface against which shotcrete is being projected.

F. Sand Pocket.....A porous area low in cement content.

G. Shotcrete.....Mortar or concrete pneumatically projected at high velocity onto a surface.

1.3 SHOP DRAWINGS

Before any products are delivered to the job site, a list of all materials to be provided under the portion of the works, including material compliance certification, manufacturer's name, catalog number, and catalog cut for each item where applicable shall be submitted to the Owner. Proposed proportions for the shotcrete mix shall also be provided as well as proportioning and test data from the Contractors prior experience. No payments shall be made for shotcrete application prior to receiving complete compliance submittals.

1.4 QUALITY ASSURANCE

A. Qualifications of Workmen.....All workmen shall be experienced in shotcrete application. Provide at least one person with a minimum of two years experience as a shotcrete nozzleman, who has had experience with the type of application required, and who shall direct all work

3E-1
performed under this section.

B. Codes and Standards -

1. In addition to complying with all pertinent codes and regulations, comply with all recommendations contained in "Specification for Materials, Proportioning, and Application of Shotcrete", Publication ACI 506.2 of the American Concrete Institute.

2. Where provisions of pertinent codes and standards conflict with the requirements of this section of these specifications, the more stringent provisions shall govern.

1.5 PRODUCT HANDLING

The Contractor shall insure the proper delivery and handling of the materials to prevent contamination, segregation, or damage. Cement shall be stored in weather-tight enclosures to protect against dampness and contamination. Segregation and contamination of aggregates will be prevented by a proper arrangement and the use of stockpiles. Admixtures shall be stored properly to prevent contamination, evaporation, freezing or other damage.

PART 2 - PRODUCTS

2.1 CEMENTS

The Contractor shall use cement conforming to one of the following standards: (1) Portland cement conforming to ASTM C-150 Type II, or (2) Blended hydraulic cement conforming to ASTM C-595, Type 1S, 1S-A, IP, or IP-A.

2.2 AGGREGATES

Aggregates to be used in the shotcrete shall conform to the following grading:

<table>
<thead>
<tr>
<th>U.S. Standard Sieve Size</th>
<th>Percent by Weight Passing the Individual Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>100</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95-100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80-100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50-85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25-60</td>
</tr>
<tr>
<td>No. 50</td>
<td>10-30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2-10</td>
</tr>
</tbody>
</table>

The aggregate shall conform to ASTM C-33 requirements.
2.3 WATER

The Contractor shall use fresh, clean, potable mixing water or use non-potable water which produces mortar cubes having 7 and 28 day compressive strengths equal to at least 90% of the strength from similar specimens made with water from a municipal supply. The Contractor shall prepare mortar cubes in accordance with ASTM C-109 for strength comparisons for Owner's approval.

2.4 ADMIXTURES

The Contractor shall use accepted admixtures meeting the requirements listed below. Unless otherwise noted, the admixtures will be dissolved in water before introduction to the mixture.

A. Chemical mixtures conforming to ASTM C-494.
B. Air entrained admixtures conforming to ASTM C-260.
C. Fly ash and pozzolanic materials conforming to ASTM C-168.
D. Other admixtures that are permitted or required by the Owner.

PART 3 - EXECUTION

3.1 PROPORTIONING OF SHOTCRETE MIX

The Contractor shall submit for acceptance proportioning and test data from prior experience. If data from prior experience is not available or accepted, the Contractor shall make and have tested specimens from three or more different mix proportions. The Contractor shall make a test panel of at least 30" x 30" for each mix being considered and for each shooting position to be encountered on the job (slab, vertical and overhead sections). The same reinforcement as to be used in the structure shall be embedded in at least half of the panels to test for proper embedment of reinforcing steel and chain-link fabric. The Contractor shall fabricate the test panels at least 3 inches thick and take at least 5 cores from the panels for compressive strength testing by the Owner. To be acceptable, all cut and broken surfaces shall be free from laminations and sand pockets.

The shotcrete proportions shall be selected to produce compressive strengths of 3,000 psi for each portion of the work unless otherwise specified. Compressive Strength Tests shall be made on specimens that have cured 28 days. The cores shall be cut from the shotcrete test panels not earlier than 5 days after shotcreting.

The shotcrete mix or mixes to be used on the project shall be approved by the Owner.

3.2 BATCHING AND MIXING

A. Mix Control.....Mixed proportions shall be controlled by weight batching or by volume batching meeting the requirements of ASTM C-685. The Owner
may permit other volume batching procedures, provided a minimum of one
weight batching check is made every 4 hours for control purposes to
ensure that the specified mixture design is being achieved.

B. Batching Equipment.....The Contractor shall use batching and mixing
equipment capable of proportioning and mixing all ingredients (except
water in the case of dry mix equipment) at a rate that will provide
adequate production with an accuracy that will insure uniformity of
batches. Weighing equipment shall be capable of batching with accuracy
specified in ASTM C-94. Volumetric equipment shall be capable of
batching with the accuracy specified in ASTM C-685.

C. Ready-Mix.....Ready-mix shall comply with the ASTM C-94, except that it
may be delivered to the shotcrete equipment in the dry state if that
equipment is capable of adding water and mixing it satisfactorily.

3.3 PREPARATION OF SURFACES
---------------------------
All rock surfaces shall be cleaned of loose material, mud and other
foreign matter that could prevent bonding of the shotcrete. Abrupt
off-sets or irregularities should be chipped to prevent an abrupt change
in thickness without suitable reinforcement. The rock surface shall be
wetted down until it is damp, but without visible free water.

3.4 PLACEMENT OF SHOTCRETE
---------------------------
The shotcrete shall be placed using a suitable delivery system approved
by the Owner, and placement procedures shall be as follows:

A. Placement Techniques.....The thickness of the shotcrete shall be
controlled, the method of support, air pressure and/or water content of
the shotcrete shall be adjusted to prevent sagging or sloughing.

B. Multiple Layers.....Shotcrete surfaces which are to receive additional
layers after hardening shall be roughened or scarified to provide for
good bonding. The surface shall be dampened just prior to application
of succeeding layers.

C. Air Supply.....A clean supply of air, adequate for maintaining
sufficient nozzle velocity for all parts of the work, and if required,
for simultaneous operation of suitable blow pipe for clearing away
rebound shall be provided.

D. Placement.....The nozzle shall be held at such a distance and angle to
place material around and behind reinforcing or chain-link fabric before
any material is allowed to accumulate on the face. In the dry mix
process, additional water may be added to the mix when encasing the
reinforcement or chain-link fabric to facilitate a smooth flow of
material behind the bars. Reinforcing steel or chain-link fabric shall
be covered by at least 3/4-inch of shotcrete.

E. Rebound.....Shotcrete shall not be placed if drying or stiffening of the
mix takes place at any time prior to delivery to the nozzle. Rebound or
previously expended materials shall not be used in the shotcrete mix.
All overspray or rebound shall be removed prior to placement of shotcrete material on these surfaces.

F. Repair of Surface Defects.....The Contractor shall remove and replace all shotcrete which lacks uniformity, exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets. Core holes for testing shall be repaired in accordance with Chapter 9 of ACI 301.

G. Finishing.....All surfaces to be shotcreted will be provided with a natural gun finish unless otherwise specified.

H. Joints.....All construction joints shall be tapered to a shallow edge about 1-inch thick. The joints shall be thoroughly cleaned and wetted prior to the application of additional shotcrete. Joints shall be made perpendicular to the main reinforcement.

I. Curing and Protection.....Immediately after finishing, shotcrete surfaces shall be kept continuously moist for at least 24 hours.

One of the following methods should be used:

1. Ponding or continuous sprinkling.
2. Absorbent mat or fabric, sand, or other covering kept continuously wet.
3. Continuous steam bath or vapor mist bath.
4. The application of a curing compound. Curing compounds shall comply with ASTM C-309. Curing compound should not be used on surfaces against which additional shotcrete layers are to be bonded.

Following the initial cure, curing shall be continued for the first 7 days after shotcreting or for the first 3 days if high early strength cement is used, or until specified strength is obtained. During the curing period, the shotcrete temperature shall be maintained above 40° F. and a moist condition shall be provided. Rapid drying shall be prevented at the end of the curing period.

J. Weep Holes.....Following the 7 day curing period where indicated on the plans and where directed by the Owner, the Contractor shall drill weep holes through the shotcrete surface to provide for drainage of the rock behind. The weep holes shall be spaced 3 feet apart in a grid pattern. The weep holes shall be a minimum of 1 inch in diameter and a maximum of 2 inches in diameter and shall penetrate at least 1 inch into the rock behind the shotcrete layer.

3.5 SHOTCRETE TESTING
-------------
A. Testing Services.....Routine testing of the shotcrete shall be performed by the Owner.

B. Scope of Testing Shall Include:.....(1) testing the proposed materials, including water for compliance with the specifications; (2) reviewing
and checking proposed mixed proportions; (3) testing pre-construction test specimens; (4) securing production samples of materials at plants or stockpiles during construction and testing for compliance with the Specifications and; (5) testing strengths of the shotcrete as the work progresses.

C. Procedure.....The testing shall include cut cores from the structure and test in accordance with ASTM C-42. A set of three cores shall be taken not less than once each shift or less than once for each 50 yards of shotcrete placed through the nozzle. Cores shall be soaked in water for a minimum of 40 hours before testing.

D. Test Frequency.....The Contractor agency shall prepare one test panel with minimal dimensions of 18" x 18" x 3", gunned in the same position as the work, representing every 50 cubic yards of shotcrete placed, but at least one panel per shift. Panels shall be gunned during the progress of the work by the Contractor's regular nozzleman. The panel shall be field cured in the same manner as the work except the test specimen shall be soaked in water for a minimum of 40 hours prior to testing. The 3-inch diameter cores shall be cut from each panel for testing.

E. Compressive Strength.....The average compressive strength of three cores taken from the structure or test panel representing, a shift or 50 cubic yards of concrete shall equal or exceed 3,000 psi with no individual core less than 75% of 3,000 psi. When the length of a core is less than twice the diameter, the correction factors given in ASTM C-42 shall be applied to obtain the compressive strength of individual cores. Final acceptance of the shotcrete by the Owner shall be based on results obtained from cores cut from the work and test panels. Use of data obtained from impact hammers, ultrasonic equipment or other non-destructive testing devices shall not be permitted for final acceptance of the shotcrete.

End Of Section
1.1 DESCRIPTION

A. Work Included....Masonry required for this work is indicated on the Drawings and includes, but is not necessarily limited to exterior walls.

B. Related Work Described Elsewhere -

1. Cast-In-Place Concrete: Section 3C.

2. Sheet Metalwork General: Section 7B.

1.2 QUALITY ASSURANCE

A. Qualifications Of Workmen -

1. For the actual cutting and placing of masonry units, use only skilled journeyman masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.

2. In acceptance or rejection of installed masonry units, no allowance will be made for lack of skill on the part of workmen.

3. Provide one skilled journeyman mason who shall be present at all times during execution of the work of this section and who shall personally direct the execution of this portion of the work.

B. Codes And Standards.....Comply with all pertinent codes and regulations including the American Society For Testing And Materials (ASTM), the Structural Clay Products Institute (SCPI), and the National Concrete Masonry Association (NCMA).

1.3 SHOP DRAWINGS

A. Certification.....Prior to delivery of unit masonry to the job site, deliver to the Owner a letter from the manufacturer of the masonry units certifying that all such masonry units delivered to the job site are in strict conformance with the provisions of this section of these Specifications.

1.4 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect masonry materials before, during, and after installation and to protect the installed work and materials of all other trades. During erection of masonry walls, protect the top of the walls at the end of each working day to prevent moisture from entering the cavity or the cores.
PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Units shall conform to applicable ASTM Specifications with additional requirements as specified.

B. Aggregate shall be lightweight, ASTM C331.

C. Hollow load bearing units shall conform to ASTM C90, Grade "N", Type I.

D. Units shall be in modular sizes. Units shall not contain iron spots or other substances that will stain paint. Exposed-to-view units in any one building shall be of the same appearance and shall be cured by the same process.

2.2 JOINT REINFORCEMENT

A. Steel reinforcement for use in horizontal bed joints of concrete masonry units as single wythe construction shall be prefabricated truss type, formed of zinc-coated, cold-drawn steel wire. Design is based on the referenced products of AA Wire Products Company. Products manufactured by Our-O-Vall Products, Inc. are approved as equal.

B. Block-trus joint reinforcement shall be used in concrete masonry construction. Block-trus shall be Standard #9 gauge by #9 gauge wire conforming to ASTM A82 for cold-drawn steel wire. Steel wire shall be zinc-coated in accordance with ASTM Specification A116-57 for Class 1 coating. The extent and location of joint reinforcement shall be as indicated on the drawings and as hereinafter specified under the laying requirements for the various items of masonry. Provide special formed pieces at corners and intersections of walls or partitions. Reinforcing shall be of proper widths for the partition and wall thickness shown.

C. Furnish joint reinforcement in proper widths for the partition and wall thicknesses shown.

2.3 MORTAR

A. Mortar for use in all masonry work shall be Type "S" (1800 psi) as described in ASTM C270. Mortar proportions (parts by volume) shall be 1 part Portland Cement and 1 part Masonry Cement with not less than 2 1/2 and not more than 3 times the sum of the volumes of cement and lime used of damp, loose aggregate, or 1/2 part portland cement, 1/4 to 1/2 hydrated lime or lime putty, and not less than 2 1/4 and not more than 3 times the sum of the volumes of cement and lime used of damp, loose aggregate (when plastic or waterproof cement is used as specified in Section 2403 of U.B.C., hydrated lime or putty may be added but not in excess of 1/10 the volume of cement.)

2.4 ADMIXTURES

A. Admixtures may be used only with the written approval of the Owner.
2.5 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of concrete unit masonry shall be as selected by the Contractor subject to approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that unit masonry may be completed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been completely resolved.

3.2 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this section.

3.3 MIXING MORTAR

A. General -

1. Use a mechanical mixer of one sack minimum capacity.

2. Mix mortar at least 3 minutes after all materials have been added.

3. Mix only as much mortar as can be used in one hour after water has been first mixed into the batch.

B. Retempering.....Do not retemper mortar.

3.4 Installation

A. General -

1. Lay up all walls plumb, level, and true to lines and dimensions indicated on the drawings.

2. Do not use chipped or broken units; if any such units are discovered in the finished wall, the owner may require their immediate removal and replacement with new units at no additional cost to the Owner.
B. Dampening.....Dampen, but do not saturate, all masonry units immediately before installation in hot, dry weather.

C. Laying Up -
1. Place all units in mortar with full shoved bed and head joints.
2. Align all vertical cells to maintain a clear, unobstructed system of flues.
3. Hold racking to an absolute minimum.
4. Fill spaces around jambs and heads of metal door bucks and frames solidly with mortar.
5. Do not lay masonry when the outside temperature is below 40°F unless suitable protection is provided and approved by the Owner.
6. Bond each course at corners in a masonry bond and at intersections with metal ties, anchors, or joint reinforcement spaced vertically not exceeding 16 inches.
7. All exterior and interior concrete masonry units shall be laid in running bond with each course of masonry bonded at corners.
8. Bond beams of the size and the reinforcing shown on the drawings shall be provided at the locations indicated.

D. Reinforcement -
1. Install all reinforcement as indicated on the Drawings.
2. Furnish and install all required metal accessories to ensure accurate alignment of steel during grout filling operations.

E. Tooling.....Tool all exposed joints to a dense, smooth surface with a concave joint.

3.5 CLEANING UP

A. Inspection And Adjustment.....Upon completion of the work of this section, make a thorough inspection of all installed masonry and verify that all units and all joints have been installed in accordance with the provisions of this section; make all necessary adjustments.

B. Cleaning -
1. Pointing And Cleaning.....Completely remove all mortar daubs or splashings, before setting or hardening. defects in joints or masonry to be exposed shall be raked out, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stains, and discoloration, and with tight mortar joints throughout.
2. Concrete-Masonry Units.....Dry-brush at end of each day’s work and after any required pointing.

3. Upon completion of all work of this section, promptly remove from the job site all mortar droppings, broken units, debris arising from the work of this section, and all tools and equipment of this section, leaving all areas in a neat orderly condition to the approval of the Owner.

End Of Section
1.1 DESCRIPTION

A. Work Included.... Structural steel required for this work is indicated on the Drawings and includes, but is not necessarily limited to:

1. Trash rack.
2. Beams.
3. Structural steel connections and accessories.
4. Bridge Railing.
5. Crane Rail.

B. Related Work Described Elsewhere -

2. Concrete Reinforcement.
3. Miscellaneous Metal.

1.2 QUALITY ASSURANCE

A. Qualifications Of Suppliers And Personnel -

1. The steel fabricator shall have not less than 5 years continuous experience in the fabrication of structural steel.
2. The steel erector shall have not less than 5 years continuous experience in the erection of structural steel.
3. All welding shall be performed by operators who have been recently qualified as prescribed in "Qualification Procedure" of the American Welding Society (except for welds which do not carry calculated stress).

B. Codes And Standards.... In addition to complying with all pertinent codes and regulations, comply with:

C. Conflicting Requirements....In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards of these Specifications, the provisions of the more stringent shall govern.

1.3 SHOP DRAWINGS

A. Before any structural steel is delivered to the job site, submit shop drawings to the Owner in accordance with the General Requirements, Section 1.1 of these Specifications.

1. Show all shop and erection details including cuts, copes, connections, holes, threaded fasteners, and welds.

2. Show all welds, both shop and field, by the currently recommended symbols of the American Welding Society.

3. Show sequence of erection and temporary staying and bracing, as required.

B. Proofs Of Compliance.....Deliver to the Owner a letter certifying that all structural steel furnished for this job is in complete accordance with these specifications.

C. Proofs Of Qualifications.....Submit to the Owner satisfactory evidence that the steel fabricator and steel erector are qualified for the work in accordance with the requirements of this section of these Specifications.

1.4 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect structural steel before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. All steel shapes and plates shall meet the requirements of ASTM A36.

2.2 BOLTS AND NUTS

A. High Strength Bolts And Nuts -

1. All high strength bolts and nuts shall meet the requirements of ASTM A325.

2. Use high strength friction bolts for all bolted connections unless otherwise indicated on the drawings.
3. Make bolt holes 1/16 inch larger than nominal bolt diameter.

4. All bolts shall have threads excluded from the shear plane.

B. Machine bolts and anchor bolts. All machine bolts and anchor bolts shall meet the requirements of ASTM A307.

2.3 PRIMER PAINT

A. General. All primer paint for structural steel shall be compatible with the finish coatings described in Section 9B of these Specifications.

B. Unfinished Structural Steel. Where no finish coating for the structural steel is described in Section 9B of these Specifications, and except for structural steel specified to not be prime coated below, primer paint shall conform to Federal Specifications TT-p-57, Type 1.

2.4 BRIDGE RAILING

A. Materials -

1. Railing shall be fabricated from structural tubing conforming to the requirements of ASTM A501 or ASTM A500 (Grade A or B). Cast-in anchor bolts shall be high strength bolts conforming to ASTM A325 or ASTM A449 with ASTM A325 nuts. Grouted-in anchor bolts shall be swedge bolts made with ASTM A36 material and shall have nuts conforming to ASTM A307.

2. Posts shall be fabricated from structural steel conforming to the requirements of ASTM A36.

3. Toggle bolt assemblies shall be fabricated from materials conforming to the following:

a. Toggle Bolt. ASTM A354 with ASTM A303 material.

b. Heavy Nut. ASTM A325.

c. Pin. ASTM A321.

4. Concrete anchorage hardware shall consist of steel bars conforming to the requirements of ASTM A36, and shall not be painted or galvanized.

B. Finish. All anchor bolts, toggle bolts, posts, and railing shall be galvanized.

2.5 CRANE RAIL

A. Crane runway rails shall be standard commercial rolled sections conforming to ASTM A759. Rails, splices and fastenings shall comply with the requirements of the crane manufacturer and as specified herein. Rail splices shall be bolted with nut and lock washer. Rails shall have milled ends and shall be drilled by the rail manufacturer to accommodate standard joint bars and provide for a tight joint. Joint bars shall be furnished by the rail manufacturer. Rail fasteners shall be single bolt
rail clips with self-locking nut, or nut and lock washer.

2.6 GALVANIZATION

A. All items, except bolted assemblies, shall be hot dip galvanized after fabrication. Galvanizing shall be performed after fabrication into the largest practicable sections and shall conform to the Specifications of ASTM A123. All welding flux shall be removed by blast cleaning before galvanizing.

B. Components of bolted assemblies shall be galvanized separately before assembly.

C. Galvanizing shall be free from general roughness, dross pimples, blisters, and wet storage stain. Excessive wet storage stain will be cause for rejection.

2.7 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of structural steel, shall be new, free from rust, first quality of their respective kinds, and subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to installation of the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that structural steel may be fabricated and erected in strict accordance with the original design, the approved shop drawings, and the referenced standards.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FABRICATION

A. General....Fabricate all structural steel in strict accordance with the approved shop drawings and the referenced standards.

B. Shop Cleaning And Priming -

1. Shop paint all structural steel 1 coat, except:
   a. Steel to be encased in concrete.
b. Surfaces to be field welded.
c. Contact surfaces to be high strength bolted.
d. Steel to be galvanized.

2. Thoroughly clean all steel to be encased in concrete.

3.3 Welding
A. General -
1. For details of joints, comply with requirements for AWS joints accepted without qualification tests.
2. Use ASTM A233, E60, or E70 series electrodes.
3. Follow applicable sections of AWS Specifications.
B. Types Of Welds..... Unless otherwise noted -
1. Make all fillet welds 1/4 inch minimum unless otherwise noted on the drawings.
2. Make all butt welds full penetration welds, using back-up or chip and back-weld.
3. Welds not required to be full penetration welds are specifically noted on the drawings.

3.4 Connections
A. Bolted connections shall be made with high-strength structural bolts in accordance with the applicable provisions of "Specifications For Structural Joints Using ASTM A325 Bolts" as approved by the Research Council On Riveted And Bolted Structural Joints of the Engineering Foundation and endorsed by the American Institute Of Steel Construction.

3.5 ERECTION
A. General..... Erect all structural steel in strict accordance with the drawings, the accepted shop drawings, and all pertinent regulations and standards. Securely fasten or anchor as required, to take care of dead load, wind load, and erection stresses.
B. Tolerance..... Align all structural steel straight, plumb, and level within a tolerance of 1 in 500.
C. Touch-up
1. After erection is complete, touch-up all shop priming coats damaged during transportation and erection, and prime all field welds, using the priming paint specified for shop priming.
2. Galvanized surfaces that are abraded or damaged at any time after the
application of the zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of paint, high zinc dust content, conforming to the requirements of Federal Specification Mil-P-21035.

D. Crane Rails.....Crane runway rails and their supports shall be erected straight, parallel and level, and within the tolerances specified in CMAA Specification No. 70. Rails shall be arranged such that joints on opposite sides of the crane runway will be staggered with respect to each other and with respect to the wheelbase of the crane. Rail joints shall not occur over joints in the runway beam, and shall be installed to provide for a tight joint. Rail clips shall be installed in opposing pairs and shall be spaced in accordance with the manufacturer's recommendations, but not more than 3 feet apart.

End Of Section
SECTION 5B - MISCELLANEOUS METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the Specifications includes miscellaneous metal items for building construction and all work incidental thereto as shown on the Drawings and specified herein.

1.2 SHOP DRAWINGS

A. As soon as practicable and prior to acquisition of materials, the Contractor shall submit shop drawings in accordance with the General Requirements, Section 1D of the miscellaneous metal items to be incorporated in the work. Drawings shall include details of fabrication, methods of assembling, connections to supporting construction and installation. For manufactured items the submittals shall be complete including drawings, performance charts, brochures, or other data necessary to demonstrate compliance of the items with the requirements of this Specification.

1.3 COMPLIANCE WITH STANDARD AND INDUSTRY SPECIFICATIONS

A. Any material or operation specified by reference to the published specifications of a manufacturer, Federal Specifications, American National Standards Institute, Inc. (ANSI) Standards, American Society For Testing And Materials (ASTM) Standards, American Welding Society (AWS) Standards, or other published standards shall comply with the requirements of the current specification or standard listed.

PART 2 - PRODUCTS

2.1 GENERAL

A. The following General Requirements shall apply to all miscellaneous metal items unless otherwise noted or specified.

B. Fabrication.....The Contractor shall verify all dimensions and shall take necessary field measurements before fabrication. Design and fabrication details of all items shall be such as to provide adequate strength and stiffness.

C. Sizes And Gage.....Sizes and gage shall be no smaller or lighter than those indicated or specified hereinafter, but slightly larger or heavier sizes and gages will generally be acceptable. Gages of materials shall be manufacturer’s standard gage.

D. Galvanizing.....Items specified to be galvanized shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A123, A386, or A525, as applicable.
E. Shop Painting.....All items not specified to be galvanized shall be shop primed in accordance with "Specification 1.24 For The Design, Fabrication, And Erection Of Structural Steel For Buildings" of the American Institute Of Steel Construction.

F. Fasteners.....All exposed-to-view fasteners shall generally match in color and finish and shall harmonize with the material to which fasteners are applied.

G. Completeness.....Materials, parts, bolts, anchors, supports, braces, and connections necessary for completion of the work shall be provided even though not precisely shown or specified. The necessary rebates, lugs, and brackets shall be provided so that the work can be assembled in a neat and rigid manner.

H. Corrosion Protection - Dissimilar Materials.....Contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood, or absorptive materials subject to wetting shall be given a protective coating conforming to Federal Specification TT-V-51.

I. Welding.....Welding shall be in accordance with AWS Code For Welding In Building Construction. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Connections to be exposed after installation shall be continuous welded. Exposed welds shall be ground smooth.

2.2 MATERIALS

A. Miscellaneous Metal Items.....Angles, beams, and other miscellaneous steel items shall be fabricated as indicated on the Drawings from steel conforming to ASTM A36.

B. Miscellaneous Anchors.....Bolts, toggles, and other miscellaneous anchoring devices shall be of the type and sizes indicated on the Drawings.

C. Manhole Steps.....Manhole steps shall be cast-iron manhole and shall meet the requirements of OSHA Section 1910.27. Manhole steps shall be equal to NEENAH Foundry Company, Catalogue No. R-1982-J, 18-inch wide treads.

D. Grating.....Grating shall be designed to support a uniform load of 150 pounds per square foot for the spans indicated, and unless otherwise indicated shall conform to Federal Specification RR-G-661. Grating size is indicated on the Drawings.

All grating shall be steel grating and shall be hot-dipped galvanized. All grating supports and support angles shall be hot-dipped galvanized.

E. Handrails, Guardrails, Collars and Sleeves.....Handrails, guardrails, collars and sleeves shall be standard weight steel conforming to the requirements of ASTM A53 or ASTM A501. Pipe shall be 1-1/2 inch size, as detailed on the Drawings. Collars shall be of the railing manufacturer's standard design.
F. Other Materials...Other materials required for the fabrication and installation of the metal work and not specified above shall be of standard commercial quality.

PART 3 - EXECUTION

3.1 MISCELLANEOUS METAL ITEMS

A. Miscellaneous metal items and anchoring devices shall be installed at the locations and in accordance with the details indicated on the Drawings.

End Of Section
SECTION 6A - LUMBER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....All wood, nails, bolts, screws, framing anchors, and other rough hardware, and all other items needed for carpentry in this work but not specifically described in other sections of these specifications.

B. Related Work Described Elsewhere.....Form lumber: Section 3A.

1.2 QUALITY ASSURANCE

A. Standards.....In addition to complying with all pertinent codes and regulations, all materials of this section shall comply with pertinent provisions of the latest publication of:

1. Douglas Fir, Hemlock, and Cedar....."Standard Grading And Dressing Rules For West Coast Lumber", Number 16, as published by the West Coast Lumber Inspection Bureau.


5. Other.....Similar or pertinent reference standards for the products needed.

B. Conflicting Requirements.....In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these specifications, the provisions of the more stringent shall govern.

1.3 SHOP DRAWINGS

A. If the Contractor desires to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

B. Shop Drawings shall be submitted in accordance with the General Requirements Section, 1.D of these specifications.
1.4 PRODUCT HANDLING

A. Protection -

1. Use all means necessary to protect lumber materials before, during, and after delivery to the job site, and to protect the installed work and materials of all other trades.

2. Deliver the materials to the job site and store, all in a safe area, out of the way of traffic, and stored up off the ground surface.

3. Identify all framing lumber as to grades and store all grades separately from other grades.

4. Protect all metal products with adequate weatherproof outer wrappings.

5. Use extreme care in the off-loading of lumber to prevent damage, splitting, and breaking of materials.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GRADE STAMPS

A. Framing Lumber.....Identify all framing lumber by the grade stamp of the West Coast Lumber Inspection Bureau.

B. Plywood.....Identify all plywood as to species, grade, and glue type by the stamp of the American Plywood Association.

C. Other.....Identify all other materials of this section by the appropriate stamp of the agency listed in the reference standards, or by such other means as are approved in advance by the Owner.

2.2 MATERIALS

All materials of this section, unless specifically otherwise approved in advance by the Owner, shall meet or exceed the following:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framing Member, Nailers, and Blocking</td>
<td>Douglas Fir-Hemlock, Standard or Better Grade</td>
</tr>
<tr>
<td>All Other Vertical Framing Members</td>
<td>Douglas Fir-Hemlock, Standard or Better Grade</td>
</tr>
<tr>
<td>Plywood</td>
<td>Standard Interior Grade With Exterior Glue</td>
</tr>
<tr>
<td>Steel Hardware</td>
<td>ASTM A-7 or A-36 (Use Galvanized at all Locations)</td>
</tr>
</tbody>
</table>
Machine Bolts  
ASTM A-307

Lag Bolts  
Federal Specification FF-B-561

Nails  
Common, Box or Finish, Federal Specification FF-N-1-1 (Use Galvanized at all Locations)

Furring Anchors  
Ramset Drive Pin or Approved Equal (5/32 x 2-1/2)

2.3 PRESSURE TREATED WOOD

---

All exterior lumber shall be pressure treated in accordance with the American Wood Preserve Institute Standards AWPA C-2 above ground. Pressure treatment shall be compatible with EPDM roof membrane.

2.4 OTHER MATERIALS

---

All other materials, not specifically described but required for a complete and proper installation as indicated on the drawings, shall be new, suitable for the intended use, and subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

---

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in area of discrepancy until all such discrepancies have been fully resolved.

3.2 WORKMANSHIP

---

A. General....All carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the drawings and with all pertinent codes and regulations.

B. Selection of Lumber Pieces -

1. Carefully select all members; select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing
or making proper connections.

2. Cut out and discard all defects which will render a piece unable to serve its intended function; lumber may be rejected by the Owner, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

3.3 GENERAL FRAMING

A. General -

1. In addition to all framing operations normal to the fabrications and erection indicated on the drawings, install all backing required for the work of other trades.

2. Set all horizontal or sloped members with crown up.

B. Bearings -

1. Make all bearings full unless otherwise indicated on the drawings.

2. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support.

3.4 FASTENING

A. Nailing -

1. Use only galvanized wire nails or spikes except where otherwise specifically noted on the drawings.

2. Provide penetration into the piece receiving the point or not less than 1/2 the length of the nail or spike provided, however, the 16d nails may be used to connect 2 pieces of 2 inch (nominal) thickness.

3. Do all nailing without splitting wood, preboring as required; replace all split members.

B. Bolting -

1. Drill holes 1/16 inch larger in diameter than the bolts being used; drill straight and true from 1 side only.

2. Bolt threads must not bear on wood; use washers under head and nut where both bear on wood; use washers under all nuts.

C. Screws -

1. Prebore holes same diameter as root of thread; enlarge holes to shank diameter for length of shank.

2. Screw, do not drive, all screws.
3.5 CLEANING UP

A. General....Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends, and debris.

B. Sweeping –

1. At the end of each working day, or more often if necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled.

2. Remove the refuse to the area of the job site set aside for its storage.

3. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

   End of Section
SECTION 7A - DAMPPROOFING

PART 1 - GENERAL

1.1 WORK INCLUDED

Damproofing required in this work is limited to foundation walls below grade.

1.2 QUALITY ASSURANCE

Qualifications of applicators: for actual application of dampproofing, use only workmen who are thoroughly trained and experienced in the skills required, who are completely familiar with the manufacturer's recommended methods of application, and who are completely familiar with the requirements of this section of these specifications.

1.3 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect dampproofing materials before, during, and after application and to protect the installed work and materials of all other trades.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURER

Design is based on the TEX-Mastic products of J & P Petroleum Products, Inc. If the Contractor desires to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute for the items specified in this section. The list shall be complete with descriptive data indicating the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

2.2 DAMPPROOFING

Dampproofing shall be as Tex-Mastic No. 670-N. Emulsion is a non-fibrated asphalt. Conformance: MIL-R-3472.
PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that dampproofing may be installed in accordance with original design and the manufacturer's current recommendations.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with application in areas of discrepancy until such discrepancies have been fully resolved.

3.2 APPLICATION

A. Preparation - Properly and thoroughly prepare all surfaces to receive dampproofing, strictly complying with the manufacturer’s recommendations.

B. Application - Apply the dampproofing in strict accordance with the manufacturer's recommendations, covering all areas where dampproofing is required to prevent penetration of moisture through the concrete walls.

3.3 BACKFILLING

Backfilling as specified shall not be started before dampproofing has been completed and approved.

End of Section
SECTION 7B - SHEET METALWORK, GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....Furnish and install all sheet metal not specifically described in other sections of these specifications, including interior sheet metal, and that are required to prevent penetration of water.

1.2 QUALITY ASSURANCE

A. Qualifications of Installers....Provide at least one person who shall be present at all times during execution of the work of this section and who shall be thoroughly trained and experienced in the materials and methods required and who shall direct the entire flashing and sheet metal fabrication and installation.

B. Codes and Standards....In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Architectural Sheet Metal Manual", Revision of January, 1970, of the Sheet Metal and Airconditioning Contractors National Association, Inc.

1.3 PRODUCT HANDLING

A. Protection....Use all means necessary to protect flashing and sheet metal materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.4 SHOP DRAWINGS

Shop Drawings shall be submitted in accordance with the General Requirements, Part 1.D of these Specifications.

PART 2 - PRODUCTS

2.1 SHEET METAL FLASHING

A. Zinc-Coated Steel....Commercial quality with 0.20% copper, ASTM A525 except ASTM A527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting: 0.0359" thick (20 gage) except as otherwise indicated.

B. Prefinished Metal Flashing....Prepainted metal, 24 gauge galvanized steel (commercial quality, extra smooth) primed and finished one side with fluoropolymer coating 1.0 ± 0.1 mil total dry film thickness, Duranar 200 by PPG Industries, Inc., masked with a plastic strippable film to protect finish during shipping, fabrication, and installation. Color shall be black. Subject to compliance with requirements, products
which may be incorporated into the work include, but are not limited to, the following:

Colorklad as manufactured by Vincent Brass and Aluminum Co., Minneapolis, MN.

2.2 ZINC COATING

A. All galvanized sheets shall have a zinc coating applied by hot-dip process to all surfaces.

B. Zinc Coating shall weigh not less than 1-1/4 ounces per square foot nor more than 1-1/2 ounces per square foot of surfaces covered.

2.3 NAILS, RIVETS, AND FASTENERS

Use only soft iron rivets having rust-resistant coating, galvanized nails, and cadmium plated screws and washers in connection with galvanized iron and steel.

2.4 SOLDER

All solder used on galvanized sheet steel shall conform with the current ASTM-32.

2.5 FLUX

All flux used for galvanized iron or steel shall be raw muriatic acid.

2.6 OTHER MATERIALS

All other materials, not specifically described but required for a complete and proper installation of sheet metal, shall be new, first quality of their respective kinds, and subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that sheet metal may be installed in accordance with the original design, all pertinent codes and regulations, and referenced standards.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such
discrepancies have been fully resolved.

3.2 WORKMANSHP
---------
A. General -
   1. Form all sheet metal accurately to the dimensions and shapes required, finishing all molded and broken surfaces with true, sharp, and straight lines and angles and, where intersecting other members, coping to an accurate fit and soldering securely.
   2. Unless otherwise specifically permitted by the Owner, turn all exposed edges back 1/2 inch.
B. Expansion - Form, fabricate, and install all sheet metal so as to adequately provide for expansion and contraction in the finished work.
C. Weatherproofing -
   1. Finish watertight and weathertight where so required.
   2. Make all lock seam work flat and true to line, and sweated full of solder.
   3. Make all lock seams and lap seams, when soldered, at least 1/2 inch wide.
   4. Where lap seams are not soldered, lap no less than 3 inches.
D. Joints -
   1. Join parts with rivets or sheet metal screws where necessary for strength or stiffness.
   2. Provide suitable watertight expansion joints for all runs of more than 40 feet except where closer spacing is indicated on the drawings or required for proper installation.
E. Nailing -
   1. Whenever possible, secure exterior metal by means of clips or cleats without nailing through the metal.
   2. In general, space all exterior nails, rivets, and screws not more than 8 inches apart and, where exposed to the weather, use lead washers.
   3. Secure interior flashing as indicated on the drawings.

3.3 SOLDERING
---------
A. General -
   1. Thoroughly clean and tin all joint materials prior to soldering.
2. Perform all soldering slowly with a well heated copper in order to heat the seams thoroughly and to completely fill them with solder.

3. Perform all soldering with a heavy soldering copper of blunt design, properly tinned for use.

4. Make all exposed soldering on finished surfaces neat, full flowing, and smooth.

B. Cleaning.....After soldering, thoroughly wash acid vlux with a soda solution.

End of Section
SECTION 7C - BUILDING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....Building insulation required for this work includes rigid wall insulations.

B. Related Work Described Elsewhere....Adhered elastomeric roofing system: Section D.

1.2 PRODUCT HANDLING

A. Protection -

1. Deliver materials to the job site and store in a safe, dry place with all labels intact and legible at time of installation.

2. Use all means necessary to protect building insulation materials before, during, and after installation and to protect the installed work and materials of all other trades.

3. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.3 SHOP DRAWINGS

Shop Drawings shall be submitted in accordance with the General Requirements, Part 1.D of these Specifications.

PART 2 - PRODUCTS

2.1 BUILDING INSULATION

A. Manufacturer....All building insulation shall be the product of the manufacturer listed below. If the Contractor desires to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

B. Rigid Wall Insulation -

1. Rigid wall insulation shall be styrofoam SM brand extruded polystyrene insulation manufactured by Dow Chemical Co., Marketed AMSPEC, Inc. The bonding adhesive shall be Dow General Purpose Mastic No. 11.

2. Insulation shall be 2 inches thick unless otherwise noted on the plans with a minimum compressive strength of 25 PSI, a maximum water vapor transmission rate of 1.1 perm-inch, and shall conform to Federal
Specification HH-1-524b, Type II Class B. Thermal conductivity "K" shall have a maximum value of 0.20 per inch at 75°F.

2.2 OTHER MATERIALS

All other materials such as fasteners and retainers, not specifically described but required for a complete and proper installation of the building insulation, shall be as selected by the Contractor subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that building insulation may be installed in accordance with the original design and the manufacturer's recommendations.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

Installation of insulation materials shall be in strict accordance with the recommendations of the insulation manufacturer and in accordance with the details on the drawings.

3.3 INSPECTION

Upon completion of the installation of insulation, visually inspect each insulated area and verify, to the approval of the Owner, that all insulation is complete and properly installed before continuing related work in that area.

End of Section
SECTION 7D - ADHERED ELASTOMERIC ROOFING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, and supervision necessary to complete the installation of an EPDM rubber roofing system.

B. The extent of the EPDM roofing system is shown on the drawings. The system is hereby defined to include all components of the EPDM rubber roofing system necessary to provide a watertight, primary roofing membrane intended for weather exposure.

1.2 QUALITY ASSURANCE

A. Roofing system applicator shall be approved in writing by the manufacturer.

1. The completed roofing project shall be inspected by the manufacturer. A ten-year watertight Membrane Systems warranty will be issued to the Owner by the manufacturer of the EPDM sheeting.

2. Make no deviation from this specification without prior written approval of the Owner.

1.3 SHOP DRAWINGS

A. Submit shop drawings for approval. Shop drawings shall be approved and assigned a number by the manufacturer. Shop drawings shall include: outline of roof and roof size, location and type of penetrations, perimeter details, penetration details, splice location, number of membrane sheets and their size, insulation type, brand and thickness.

B. Manufacturer's roofer approval certificate.

C. Sample ten-year watertight membrane systems warranty.

D. Manufacturer's current roofing brochure.

E. Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.

1.4 PRODUCT DELIVERY STORAGE AND HANDLING

A. Deliver materials in original, unopened containers.

B. Containers shall show manufacturer's name, brand name, and installation instructions.

C. All materials except the membrane must be stored between 60°F and 80°F. If exposed to lower temperatures the materials must be restored to 60°F before using.
D. All materials except the membrane must be stored in a dry area.

E. Membrane may be stored outside but must be protected from mechanical damage.

1.5 PROJECT SITE CONDITIONS

A. The roof deck shall be free of water, ice, or snow.

B. Splicing of the membrane shall not be done during rain or snow.

1.6 WARRANTY

A. A representative of the manufacturer shall inspect the installation of the roofing system. Upon approval a ten-year watertight Membrane Systems warranty shall be issued by the manufacturer. The warranties will be in effect on the date of the completed inspection.

PART 2 - PRODUCTS

2.1 GENERAL

Membrane system components to be products of a single manufacturer or certified and warranted to be compatible by the membrane manufacturer on company letterhead.

2.2 MEMBRANE

EPDM rubber nonreinforced roofing membrane as manufactured by Carlisle Syntec Systems, .06 inch thick, the largest sheet possible as determined by job condition. EPDM (ethylene propylene diene monomer) compounded elastomer shall conform to the following minimum physical properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance on Nominal Thickness, %</td>
<td>ASTM D 412</td>
<td>+/-10</td>
</tr>
<tr>
<td>Tensile Strength Min. PSI (MPa)</td>
<td>ASTM D 412</td>
<td>1305 (9)</td>
</tr>
<tr>
<td>Elongation, Ultimate Min, %</td>
<td>ASTM D 412</td>
<td>350</td>
</tr>
<tr>
<td>Tear Resistance Min. LBF/In (kN/m)</td>
<td>ASTM D 624</td>
<td>175 (30.6)</td>
</tr>
<tr>
<td>Factory Steam Strength Min</td>
<td>Modified</td>
<td>Membrane Rupture</td>
</tr>
<tr>
<td></td>
<td>ASTM D 816</td>
<td></td>
</tr>
<tr>
<td>Resistance to Heat Aging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properties after 4 weeks @ 240°F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile strength min. PSI (MPa)</td>
<td>ASTM D 412</td>
<td>1200 (8.3)</td>
</tr>
<tr>
<td>Elongation, ultimate min, %</td>
<td>ASTM D 412</td>
<td>225</td>
</tr>
<tr>
<td>Tear Resistance, min. lbf/in (kN/m)</td>
<td>ASTM D 624</td>
<td>150 (26.3)</td>
</tr>
<tr>
<td>Linear dimensional change max, %</td>
<td>ASTM D 1204</td>
<td>+/-2</td>
</tr>
</tbody>
</table>
Ozone Resistance  
Condition after exposure to 100 ppbm  
Ozone in air for 168 h @ 104 degrees F  
Specimen is at 50% strain

Brittleness Temperature Max. degrees F  
(degrees C). 

Resistance to Water Absorprtion  
Change in mass max. after 7d immersion  
@ 158°F.

Water Vapor Permeability max. perm-mils

Resistance to Outdoor (Ultraviolet)  
Weathering  
Properties after 500,000 Langleys  
EMMAQUA 50% strain, calendar sheeting  
Tensile Strength min. PSI (MPa)  
Elongation min, %

Sheet Composition  
Weight percent of polymer that is EPDM,  
min, %  
Weight percent of sheet that is EPDM polymer, min, %

2.3 RELATED MATERIALS

A. Roof flashing membrane shall be as furnished by the membrane manufacturer for this sytem, as indicated on the drawings.

B. Adhesives, cements, sealants and miscellaneous items necessary for a complete insulation shall be furnished by the membrane manufacturer or certified and warranted to be compatible by that manufacturer on company letterhead.

C. Roof Insulation shall be Dow Styrofoam RM, 2" thick with an 4=100. Insulation shall meet federal specifications HH-1-524B; ASTM C-272 and D-1621.

D. Fascia or gravel stop shall be hard rubber edging as manufactured by Carlisle Syntec Systems or as approved by membrane manufacturer.

E. Protective mat shall be a "HP protective mat" as furnished by the membrane manufacturer.

F. Stone ballast shall be size #57 according to ASTM D 448 (nominal 3/4 inch with fines smaller than 1/2 inch not less than 10% or more than 50%) smooth, river gravel.

7D-3
2.4 EQUAL PRODUCTS

A. If the Contractor desires to furnish other than scheduled materials, he shall before submitting make certain the materials are equal to those in the specifications. He may then submit a list of the methods and materials he wishes to substitute for the items specified in this specification. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted. Materials shall meet requirements of referenced federal specifications, American Society for Testing and Materials Standards, and requirements specified herein. The list shall contain the following:

1. Membrane physical properties.
3. Proof of single source manufacturing or warranty of all system components by the EPDM membrane manufacturer.
4. List of approved system applicators.
5. Sample ten-year watertight warranty.

B. PVC and other thermoplastic sheets will not be considered for base bid.

PART 3 - EXECUTION

3.1 GENERAL

Install roof insulation, roof membrane, and all other items necessary for the installation of the roofing system in accordance with manufacturer's latest specifications, approved shop drawings, and these specifications. Use manufacturer's specification for adhered systems for membrane installation.

3.2 SUBSTRATE PREPARATION

A. The concrete roof slab shall be dry and free of any dirt or debris before installation of any components of the roofing system.

3.2 INSTALLATION

A. Membrane.....Install as per manufacturers specifications for an adhered system.

B. Nailers.....Install pressure treated wood nailers around the perimeter of the roof and as indicated on the drawings. Nailers shall be anchored to resist a force of 75 pounds per lineal foot in any direction.

C. Flashing.....Flash around scuppers and any other penetrations shall be done with EPDM flashing using the longest pieces practical. Splice shall extend at least three inches beyond each side of joint. All
flashings and terminations shall be done in accordance with manufacturer's approved details. In addition to the flashing required by the manufacturer, install a continuous piece of flashing around the perimeter of the road and extend a minimum of 18" onto the road membrane as indicated on the Drawings.

D. Daily Seal.....Exercise care to ensure that water does not flow beneath any completed sections of roof. Temporarily seal loose edge of membrane with nite seal when weather is threatening.

E. Fascia.....Install fascia in 8'-0" minimum lengths in accordance with manufacturers recommendations.

F. Insulation -

1. Place the insulation up protective mat and ballast the membrane as each section of the membrane installation is completed in order to provide immediate protection.

2. Examine the roof area to be covered in order to insure that all membrane splices and field seams have been completed and sealed with lap sealant, all flashing has been installed, and that all membrane terminations have been completed before application of insulation on the membrane.

a. Place STYROFOAM RM brand insulation directly on the membrane with the channel side down.

b. Tightly abut all boards; the maximum acceptable opening between boards is 3/8 inch.

c. Install the subsequent top layer unattached over the loose-laid first layer. All joints between the insulation boards of both layers should be staggered in relation to the underlying layer.

The minimum thickness of the bottom layer is 2 inches and it must be as thick or thicker than the top layer.

G. Fabric Installation -

1. Place HP Protective Mat over STYROFOAM RM brand insulation. Apply the fabric unadhered and unattached. Install the fabric so that the wind direction is with the laps rather than against the laps.

a. Overlap all edges one foot minimum.

b. Install such that there are no joints parallel to and within 6 feet of the perimeter.

c. Extend the fabric 2 to 3 inches above the stone at perimeter and penetrations.

d. The fabric should be extended to the base of scuppers, but should not cover the scupper outlet or restrict flow to the outlet.
e. Additional fabric should be installed around penetrations in order to prevent stone entry into the space between the penetration and the insulation.

2. Immediately following the application of the fabric, it is necessary to install the stone or gravel ballast. On windy days, the stone shall be installed closely following the fabric in order to help prevent the blow-off of unballasted fabric and insulation.

H. Ballast -

1. Apply the stone or gravel ballast at a minimum of 12 pounds per square foot regardless of the insulation thickness. The combination of ballast gradation and amount (depth) must be adequate to completely cover the fabric.

2. Place at least 20 pounds per square foot of stone ballast over a 4' wide area:
   - around the roof perimeter
   - at penetrations
   - wherever the insulation boards stop.

3.3 CLEANUP

All debris, scraps, containers, and other rubbish and trash resulting from the installation of the roofing system shall be removed from the jobsite daily.
SECTION 7E - SEALANT
-----------------------------------
PART 1 - GENERAL
-----------------------------------
1.1 DESCRIPTION
-----------------

A. Work Included -

1. The purpose of sealant in this work is to provide a positive barrier against penetration of air and moisture at joints between items where caulking and sealant are essential to continued integrity of the barrier.

2. Such sealant will normally be performed under the work of various sections of these specifications but shall be performed in strict accordance with the provisions of this section.

1.2 QUALITY ASSURANCE
------------------------

A. Qualifications of Applicators.....Installation of sealant shall be performed only by workmen thoroughly skilled and specially trained in the techniques of sealing and who are completely familiar with the published recommendations of the manufacturer of the sealant material being used.

B. Rejection of Installed Sealant.....Indication of lack of skill on the part of sealant installers shall be sufficient grounds to the Owner to reject installed caulking and sealant and to require its immediate removal and complete resealing at no additional cost to the Owner.

1.3 PRODUCT HANDLING
-----------------------

A. Protection.....Use all means necessary to protect sealant materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of and at no additional cost to the Owner.

C. Storage -

1. Store all sealant materials and equipment under conditions recommended by its manufacturer.

2. Do not use materials stored for a period of time exceeding the maximum recommended shelf-life of the material.

1.4 SHOP DRAWINGS
---------------------

Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.
PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

A. Manufacturer.

Sealant is based on the referenced products listed below. If the Contractor desire to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

B. Sealant shall be Dow Corning 790 one-component sealant.

C. Sealant Equipment.

All sealant equipment shall be only such equipment as is specifically recommended by the manufacturer of the material being installed.

2.2 OTHER MATERIALS

All other materials not specifically described but required for a complete and proper application of sealant shall be selected by the Contractor as recommended by the manufacturer and subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspections -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that sealant may be installed in accordance with the manufacturer’s recommendations.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 BACK-UP MATERIALS

A. General -

1. Verify that compatibility of filler material with sealant before installation.
2. Use filler about 1/3 to 1/2 wider than width of joint so sufficient pressure is exerted by filler to provide substantial resistance to displacement.

B. Acceptable Materials... All filler materials shall be non-oily, non-staining back-up filler such as polyethylene foam rod, expanded polyurethane, neoprene, or other filler completely compatible with the sealant material.

3.3 APPLICATION OF SEALANT

Install sealant in strict accordance with the manufacturers' recommendations, taking care to produce beads of proper width and depth, to tool as recommended by the manufacturers, and to immediately remove all surplus sealant.

3.4 SEALANT SCHEDULE

Carefully study the drawings and furnish and install the proper sealant at each point where called for on the drawings plus at all other points where sealant is essential in maintaining the continued integrity of the watertight barrier.

End of Section
SECTION 8A - METAL DOORS, FRAMES, AND HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....The metal doors and frames required for this work are indicated on the drawings.

B. Related work described elsewhere -

1. Finish painting: Section 9B.

1.2 QUALITY ASSURANCE

A. Qualifications of Installers....For actual installation of metal doors, frames, and hardware, use only personnel who are thoroughly trained and experienced in the skills required and who are completely familiar with the manufacturers' recommended methods of installation as well as the requirement of this work.

B. Provide shop drawings showing all items furnished, door elevation, and large scale details of principal construction features.

1.3 PRODUCT HANDLING

A. Protection -

1. Deliver, store, and handle all metal doors, frames, and hardware in a manner to prevent damage and deterioration.

2. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrapping as required to completely protect all metal doors, frames, and hardware during transportation and storage.

3. Store doors upright, in a protected dry area, at least 1 inch off the ground, and with at least 1/4 inch air space between individual pieces; protect all prefinished and hardware surfaces as required.

4. Use all means necessary to protect the installed work and materials of all other trades.

B. Replacements....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.
PART 2 - PRODUCTS

---

2.1 GENERAL

Door Nos. 1, 3, 4, and 5, and the frames for Door No. 1, 4 and 5 (Door No. 3 has no frame) shall be the products of one manufacturer. Design of these doors and frames are based on products of Chicago Bullet Proof Equipment Company. Hardware shall be as indicated below.

If the Contractor desires to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute for the items in the door schedule. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

2.2 DOOR NOS. 1, 3, 4 and 5

---

A. Materials....Doors shall be made of UL Listed Shot-Tex brand bullet-resisting steels complying with UL 752 and other code criteria if applicable. Steel shall be free of scale, pitting or other surface defects. Face sheets for doors shall be not less than 1/8". Door shall have a ballistic rating of UL-HPR.

B. Design and Construction –

1. All doors shall be of fully welded construction with no visible seams or joints on their faces or vertical edges. Door thickness shall be 1 3/4".

2. Face sheet shall be stiffened by continuous horizontal formed steel sections spanning the full thickness of the interior space between door faces. These stiffeners shall be not less than 1/8", spaced not more than 24" apart and securely attached to face sheets by fillet welds not more than 8" on center. Spaces between stiffeners shall be insulated the full height of the door with an inorganic non-combustible batt-type material. Door interior faces and reinforcements shall be galvanized in accordance with ASTM A90.

3. Door faces shall be jointed at their latchside, or unhinged edges by a continuous weld extending the full height of the door; hingeside edge of Door No. 1, 4 and 5 shall be joined by groove welds at no more than 8" o.c. all such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface prior to prime painting.

4. Top and bottom edges of all doors shall be closed with a continuous recessed steel angle not less than 1/8" thick, extending the full width of the door and welded in place. Doors shall have an additional flush closing channel at their top edges and a flush closure at their bottom edges. Openings shall be provided in the bottom closure of doors to permit the escape of entrapped moisture.
5. Hardware reinforcements.
   a. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only as required.
   b. Minimum gages for hardware reinforcing plates shall be 1/8".

6. Provide angles 1-1/2 x 1-1/2 x 1/4 x 0'-8" and 1-1/2 x 1-1/2 x 1/4 x 0'-2" at the locations indicated on the Drawings.

7. Finish....After fabrication, all tool marks and surface imperfections shall be dressed, filled and sanded as required to make all faces and vertical edges smooth, level and free of all irregularities. Doors shall then be chemically treated to insure maximum paint adhesion and shall be spray-painted on all exposed surfaces, with a rust-inhibitive primer fully cured before shipment.

2.3 FRAMES FOR DOOR NO. 1, 4 and 5
-----------------------------
A. Materials....Frame shall be made from Shot-tex brand steels conforming to UL752 and other code criteria if applicable and free of scale, pitting and other surface defects. Metal thickness shall be no less than 1/8". Frame shall have a ballistic rating of UL-HPR.
B. Design and Construction -
   1. Door and frame shall be assemblies, and shall not be procured separately. All doors shall be prehung and prefit within their frames using clearances of 1/8" at hand and jambs and 3/4" at the sill.
   2. All frames shall be mitered and welded units of the sizes, swings, and shapes indicated. Knocked-down frames will not be accepted.
   3. Reinforce frames for hardware installations at hinge and strike locations. Reinforcement shall be 1/8" steel plate.
   4. Provide floor anchor welded to each jamb.
   5. Provide countersunk and reinforcing to accept 1/2 Ø anchor bolts at 24" o.c. at each jamb for door #1. Provide 4 jamb anchors/jamb for doors 4 and 5.
C. Finish.....Pre-clean and shop prime the frame for finish painting which will be performed at the job site under Section 9B of these specifications.

2.4 HARDWARE GROUPS
-----------------------------
A. Hardware for Door No. 1 and 5 shall be provided by the door manufacturer as a part of the door assembly the following hardware items.
   1. Lockset....Sargent 18-7704 mortise lock x KBC x Us26D, with keyed cylinder positioned on the threat side of the door and operative knob on
protected side of the door. Lockset shall be ballistic certified to a protection level no less than that provided by door/frame, and have latchbolt throw no less than 5/8". Strike shall be ANSI type A115. Function of lockset shall be ANSI F07.

2. Hinging.....CBP 12252 heavy-duty stainless steel continuous hinge, having 1/4" minimum diameter full length, non-removable pin; hinge leaves and knuckles shall be 1/8" minimum thickness. Hinge shall be ballistic certified to a protection level no less than that provided by door/frame. Knuckle height shall be 2" minimum. Hinge shall be secured to door and frame with #12-24 screws in a double row, spaced 8" O.C. vertically.

3. Silencers.....Glynn-Johnson #64.

4. Closer.....Scovill/Yale 406 closer x SB finish. Closer shall be installed on the protected side of the door/frame assembly.

5. Threshold.....Dorbin #79A x mill finish x 1/2" high aluminum saddle.

6. Gasketing.....Zero #328A x mill finish aluminum x neoprene bulb gasketing for head, jamb and sill protection.

B. Hardware for Door No. 3 shall be provided by the door manufacturer as a part of the door assembly the following items.

1. Trollies.....Size and number to support door and provide for manual operation.

2. Track.....Size and weight as required for smooth operation.

3. Brackets.....Center brackets as required to support door and track spaced not more than 2'-0" o.c. Provide two end brackets for each leaf.

4. Stay roller.....Provide a minimum of two stay rolls per leaf, manufacturers standard.

C. In addition to the above hardware, provide the following hardware items for Door No. 3.

1. Padlock.....Provide one Sargent #1756 padlock.

D. Hardware for Door No. 4 shall be provided by the door manufacturer, as a part of the door assembly, the following items:

1. Lockset (active leaf).....Sargent 18-7704 mortise lock x KBC x Us26D, with keyed cylinder positioned on the threat side of the door and operative knob on protected side of the door. Lockset shall be ballistic certified to a protection level no less than that provided by door/frame, and have latchbolt throw no less than 5/8". Strike shall be ANSI type A115. Function of lockset shall be ANSI F07.

2. Hinging (both leaves).....CBP 12252 heavy-duty stainless steel continuous hinge, having 1/4" minimum diameter full length,
non-removable pin; hinge leaves and knuckles shall be 1/8" minimum thickness. Hinge shall be ballistic certified to a protection level no less than that provided by door/frame. Knuckle height shall be 2" minimum. Hinge shall be secured to door and frame with #12-24 screws in a double row, spaced 8" O.C. vertically.

3. Silencers (both leaves).....Glynn-Johnson #64.

4. Closer (active leaf).....Scovill/Yale 406 closer x SB finish. Closer shall be installed on the protected side of the door/frame assembly.

5. Threshold (both leaves).....Dorbin #79A x mill finish x 1/2" high aluminum saddle.

6. Gasketing (both leaves).....Zero #328A x mill finish aluminum x neoprene bulb gasketing for head, jamb and sill protection.

7. Flush Bolts (inactive leaf).....Glynn-Johnson #GR1631 and #GR1632.

PART 3 - EXECUTION
-----------------------------------------------

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to installation of metal doors and frames, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that metal doors and frames may be installed in strict accordance with all pertinent codes and regulations, the original design, approved shop drawings, and manufacturer's recommendations.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Metal Doors and Frames.....Install all metal doors and frames in strict accordance with all pertinent codes and regulations, the approved shop drawings, and the manufacturer's recommendations, anchoring all components firmly in position for long life under hard use.

B. Finish Hardware.....Install all hardware in strict accordance with the manufacturer's recommendations, eliminating all hinge-bound conditions and making all items smoothly operating and firmly anchored into position.

End of Section
SECTION 8B - OVERHEAD COILING DOOR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work in this section includes the furnishing and installation of overhead coiling door (Door No. 2) as specified herein. The extent and locations of overhead coiling door are indicated on the drawings and by provisions of this section.

B. Unless otherwise approved by the Owner, furnish complete operating door assemblies including door curtains, guides, frames, counterbalance mechanisms, hardware, operators and installation accessories.

1.2 QUALITY ASSURANCE

A. Furnish the overhead coiling door as a complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.

B. Inserts and Anchorages... Furnish inserts and anchoring devices which must be set in concrete for the installation of the units. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

C. Wind Loading... Design and reinforce overhead coiling doors to withstand a 25 pound per square foot wind loading pressure unless otherwise indicated.

1.3 SHOP DRAWINGS

A. Product Data... Submit manufacturer's product data, roughing-in diagrams, and installation instructions for the type and size of overhead coiling door. Include operating instructions and maintenance information.

B. Shop Drawings... Submit shop drawings for special components and installations which are not fully dimensioned or detailed on manufacturers data sheets.

C. Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers... Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

   Apton Door, Div. of the Union Corp.
The Cookson Company
Cornell Iron Works, Inc.
Kinnear Div., Harsco Corp.
Mahon Rolling Door Div.
North American Door, Div. of Jim Walters

2.2 MATERIALS AND CONSTRUCTION

A. Door Curtain.....Fabricate overhead coiling door curtain of interlocking slats designed to withstand required wind loading, of continuous length for width of door without splices. Unless otherwise indicated, provide slats of material gage recommended by door manufacturer for size and type of door required, and as follows:

1. Aluminum Door Curtain Slats.....Furnish with manufacturer’s standard galvanized finish.

2. Furnish manufacturer’s standard "flat-face" slats.

B. Endlocks.....Malleable iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Windlocks.....Malleable iron castings secured to curtain slats with galvanized rivets. Unless otherwise recommended by door manufacturer, provide windlocks on doors exceeding 16' wide. Space windlocks approximately 24" o.c. on both edges of curtain.

D. Bottom Bar.....Consisting of 2 angles, each not less than 1-1/2" x 1-1/2" x 1/8" thick, aluminum extrusion. Provide a replaceable gasket of flexible vinyl or neoprene between angles as a weather seal and cushion bumper for manually operated doors unless shown as an overlapping joint.

E. Curtain Jamb Guides -

1. Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build-up units with minimum 3/16" thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.

2. Secure continuous wall angles to wall framing by 3/8" minimum bolts at not more than 30" o.c., unless closer spacing recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise shown. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain, and continuous bar for holding windlocks, if any.

F. Weather Seals.....Provide vinyl or neoprene weatherstripping for exterior exposed doors except where otherwise noted. At door heads, use 1/8" thick continuous sheet secured to inside of strip secured to exterior side of jamb guide.
G. Locking....Provide locking by padlock on coil side.

H. Insulation....Provide solid polyurethane insulation; provide manufacturer's galvanized steel cover slats.

2.3 COUNTERBALANCING MECHANISM

A. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and mounted in a spring barrel and connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel -

1. Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll-up of curtain without distortion of slats and limit barrel deflection to not more than 0.03" per foot of span under full load.

2. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

3. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold fixed spring ends and carry torsional load.

C. Brackets....Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bell-mouth guide groove for curtain.

D. Hood....Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag. Fabricate steel hoods for doors of not less than 24 gage hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 525. Phosphate treat before fabrication.

2.4 PAINTING

Shop clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except faying and lubricated surfaces, with door manufacturer's standard rust inhibitive primer.

2.5 DOOR OPERATORS

Provide manual chain hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and geared reduction unit with maximum 35 pounds pull for door operation. Design chain hoist with self-locking mechanism allowing curtain to be stopped at any point in its travel and to remain in position until movement is reactivated.
Furnish alloy steel hand chain with chain holder secured to operator guide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.

B. Provide overbalance doors where indicated by adjusting counterbalance to open door two to three feet when unlocked.

C. Equip overbalance doors with cylinder locks. Equip all other doors for locking by padlock from coil side.

D. Upon completion of installation including work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and fitting weathertight for entire perimeter.

End of Section
SECTION 9A - GYPSUM WALLBOARD (DRY WALL)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....Gypsum drywall and metal support system for this work is required on all interior walls indicated on the drawings.

B. Related Work Described Elsewhere.....Lumber: Section 6A.

1.2 QUALITY ASSURANCE

A. Qualifications of Installers -

1. Use only skilled and experienced gypsum drywall installers for laying up the gypsum board, fastening, taping, and finishing.

2. Helpers and apprentices used for such work shall be under full and constant supervision at all times by thoroughly skilled gypsum drywall installers.

3. In the acceptance or rejection of installed gypsum drywall, no allowance will be made for lack of skill on the part of installers.

B. Manufacturer's Recommendations.....The manufacturer's recommended methods of installation, when approved by the Owner, shall be the basis for acceptance or rejection of actual installation methods used in this work.

1.3 PRODUCT HANDLING

A. Protection.....Use all means necessary to protect gypsum drywall materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.

PART 2 - PRODUCTS

2.1 WALLBOARD

Moisture-resistant gypsum wallboard shall be MR Board as manufactured by Gold Bond Building Products, 5/8 inch thick, clearly labeled as moisture
resistant, and conforming with the requirements of ASTM C-36-67.

2.2 JOINT SYSTEM

A. All joint system, including tape and compound, shall be a system recommended as compatible by the manufacturer of the gypsum wallboard.

B. Areas to be treated shall be inspected to ascertain wallboard fits tightly against supporting framework.

C. Fasteners shall be the length and type recommended by the manufacturer of the gypsum wallboard used.

D. All metal corner bead and trim shall be a system recommended as compatible by the manufacturer of the gypsum wallboard. Edge beads shall be angle-shaped with wings not less than 3/4 inch wide. Concealed wing shall be perforated for nailing and exposed wing edge folded flat. Edge beads shall be used whenever gypsum board abuts or intersects dissimilar construction and where indicated on the drawings.

E. All other materials, not specifically described but required for a complete and proper installation of gypsum drywall, shall be as selected by the Contractor subject to approval of the Owner.

2.3 METAL SUPPORT SYSTEM

A. Z-Furring Members.....Manufacturer's standard screw-type galvanized steel, zee-shaped furring members; ASTM A 525, G60, 0.0179" min. thickness of base metal; of 2" depth; designed for mechanical attachment of insulation boards to monolithic concrete walls.

B. Fasteners for Furring Members.....Type and size recommended by furring manufacturer for the substrate and application indicated.

C. Manufacturer.....Subject to compliance with requirements, provide products of one of the following:

Dale Industries, Inc.
Gold Bond Building Products Div., National Gypsum Co.
Milcor Division; Inryco Inc.
United States Gypsum Co.

2.4 VAPOR BARRIER

4.0 mil thick polyethylene film.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the
point where this installation may properly commence.

2. Verify that gypsum drywall may be installed in accordance with the original design, all pertinent codes and regulations and the manufacturer's recommendations as approved by the Owner.

B. Discrepancies -

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 METAL SUPPORT SYSTEM INSULATION

A. Install metal support system in compliance with ASTM C 754.

B. Erect thermal insulation vertically and hold in place with Z-furring members spaced 24" o.c. Except at exterior corners, secure attach narrow flanges of furring members to wall with concrete stub nails or power-drive fasteners spaced 24" o.c. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw attach short flange or furring channel to web of attached channel. Start from this furring channel with standard width insulation panel and continue in regular manner. At interior corners, space second member no more than 12" from corner and cut insulation to fit. Until gypsum board is installed hold insulation in place with 10" staples fabricated from 18-gage tie wire and inserted through slot in web of member, or by an equally acceptable method.

3.3 POLYETHYLENE VAPOR RETARDER

Install polyethylene vapor retarder on interior of framing members of exterior insulated walls. Seal joints by lapping and bonding with adhesive or vapor retarder tape. Extend coverage to extremities of areas to receive retarders. Seal punctures, tears and penetrations through retarders with vapor retarder tape or strips of vapor retarder material adhesively applied.

3.4 INSTALLATION

A. General....Install all panels plumb, level, and with all vertical joints on bearing.

B. Cutting -

1. When cutting gypsum drywall is required, cut by scoring and breaking or by sawing, working from the face side.

2. When cutting by scoring, cut through the face paper and then pull the panel back away from the cut face; then break the back panel by snapping the gypsum board in the reverse direction or by cutting the back paper.
3. Smooth all cut ends and edges of panels as necessary to obtain a smooth joint.

4. For cut-outs in panels for pipes, fixtures, and other small openings, make holes and cut-outs by sawing or by such other method as will not fracture the core or tear the covering and with such accuracy that plates, escutcheons, or trim will cover the edges.

5. The use of "score-and-knockout" method will not be permitted.

C. Fastening –

1. Properly space all fasteners in careful accordance with the manufacturer’s recommendations and code requirements, with heads driven slightly below the surface for proper cementing but without breaking the paper cover.

2. Loosely butt all joints to be taped; firmly butt all joints to be left untreated.

3. Stagger all end joints and the joints between panels to achieve a maximum of bridging and a minimum of continued joints.

3.5 INSTALLING METAL TRIM

A. General....The drawings do not purport to show all metal trim required; verify with the Owner the precise locations and types of trim to be used.

B. Installation –

1. Carefully inspect the drawings and verify location of all metal trim required.

2. Install all trim in strict accordance with the manufacturers’ recommendations, paying particular attention to make all trim installation plumb, level, and true to line, with firm attachment to supporting members.

3.6 TAPING AND FINISHING

A. Environmental Conditions....Control heating and ventilating during finishing operations to ensure the maintenance of 55°F. minimum temperature.

B. First Coat –

1. Spread compound evenly over all joints, using suitable tools designed for the purpose.

2. Fill all joint recesses and metal trim.

3. Center the reinforcing tape on the joint and press into the fresh
compound, wiping down with sufficient pressure to remove excess compound but leaving sufficient compound under the edge for the bond.

4. Feather all edges and leave the surface free from blisters and tape wrinkles.

5. Apply compound to all fastener recesses, leaving flush with the adjacent surfaces.

6. Fold reinforcing tape along its centerline and apply to all interior angles, following the same procedure as for joints.

C. Second Coat -

1. Lightly sand the dry compound with fine sandpaper to remove all irregularities.

2. Apply a second coat of compound to all joints, feathering approximately three inches beyond edges of tape.

3. Apply second coat to all fastener recesses; allow to dry.

D. Third Coat -

1. Lightly sand the dry compound with fine sandpaper to remove all irregularities.

2. Apply final skim coat, feathering out approximately two inches beyond second coat.

3. third coat all fastener recesses and metal trim, and all interior angles; allow to dry.

3.7 CLEANING UP

Do not allow the accumulation of scraps and debris arising from the work of this section but maintain the premises in a neat and orderly condition at all times; in the event of spilling or splashing compound onto other surfaces, immediately remove the spilled or splashed material and all trace of the residue to the approval of the Owner.

End of Section
SECTION 9B - PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....The type of material to be used and the number of coats to be applied are listed in the "Painting Schedule" in Part 3 of this section of these specifications.

B. Related Work Described Elsewhere -

1. Prefinishing.....Shop priming and factory prefinishing are required on some, but not all, of the items described in other sections of these specifications.

2. Caulking.....Basic requirements for caulking are described in Section 7E.

C. Definitions.....The term "Paint" as used herein includes paints, epoxys, enamels, and other coatings whether used as prime, intermediate or finish coats.

1.2 QUALITY ASSURANCE

A. Qualifications of Painters.....Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces; in the acceptance or rejection of installed painting, no allowance will be made for lack of skill on the part of painters.

B. Codes and Standards.....Painting shall comply with all pertinent codes and regulations.

1.3 PRODUCT HANDLING

A. Delivery.....Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.

B. Protection -

1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.

2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.

3. Use all means necessary to protect paint materials before, during, and after application and to protect the installed work and materials of all other trades.
C. Replacements.....In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

1.4 EXTRA STOCK

Upon completion of this portion of the work, deliver to the Owner an extra stock of paint equaling approximately 10% of each color used in each coating material used, with all such extra stock tightly sealed in clearly labeled containers.

1.5 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Part 1.D of these specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURER

The paints and painting systems shall be those indicated in the painting schedule. If the Contractor desires to furnish other than scheduled materials, he shall, before submitting, make certain the materials are equal to those in the specifications. He may then submit a list of the materials he wishes to substitute. The list shall be specific in nature indicating the specific materials he wishes to substitute for the items in the paint schedule. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

2.2 COMPATIBILITY

A. All paint materials and equipment shall be compatible in use: finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; all tools and equipment shall be compatible with the coating to be applied.

B. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that paint finishes may be applied in strict accordance with all pertinent codes and regulations and the requirements of these specifications.

9B-2
B. Discrepancies –

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION OF SURFACES, GENERAL

A. Protection....Prior to all surface preparation and painting operations, completely mask, remove, or otherwise adequately protect all hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces but not scheduled to receive paint.

B. Priming.....Spot prime all exposed nails and other metals which are to be painted with emulsion paints using a primer recommended by the manufacturer of the coating system.

C. Cleaning –

1. Before applying paint or other surface treatment thoroughly clean all surfaces involved.

2. Schedule all cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

3.3 PREPARATION OF WOOD SURFACES

A. Cleaning....Clean all wood surfaces until they are free from dirt, oil, and all other foreign substance.

B. Smoothing –

1. Unless specifically noted to be left rough, smooth all finished wood surfaces exposed to view, using the proper sandpaper.

2. Where so required, use varying degrees of coarseness in sandpaper to produce uniformly smooth and unmarred surfaces.

C. Allow to dry thoroughly before application of paint.

3.4 PREPARATION OF METAL SURFACES

A. Galvanized Metal.....Clean all surfaces thoroughly with solvent until they are completely free from dirt, oil, and grease.

B. Other Metals –

1. Thoroughly clean all surfaces until they are completely free from dirt, rust, oil, and grease.

2. Allow to dry thoroughly before application of paint.
3.5 PAINT APPLICATION

A. General....The following listed items and surfaces shall not require painting:

   Hardware Items
   Factory Finished Items
   Grating

B. Drying -

1. Allow sufficient drying time between coats.

2. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.

C. Environmental Conditions -

1. Comply with the manufacturer’s recommendations as to environmental conditions under which the coating systems may be applied.

2. Do not apply paint in areas where dust is being generated.

D. Defects.....Sand and dust between coats to remove all defects visible to the unaided eye from a distance of 5 feet.

E. Color of Undercoats.....Slightly vary the color of succeeding coats.

3.6 INSPECTION

A. General.....Do not apply additional coats until completed coat has been inspected and approved by the Owner.

B. Number of Coats.....Only inspected and approved coats of paint will be considered in determining the number of coats applied.

3.7 REINSTALLATION OF REMOVED ITEMS

Following completion of painting in each space, promptly reinstall all items removed for painting, using only workmen skilled in the particular trade.

3.8 CLEAN UP

A. General -

1. During progress of the work, do not allow the accumulation of empty containers or other excess items except in areas specifically set aside for that purpose.

2. Prevent accidental spilling of paint materials and, in event of such spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surfaces to their original undamaged condition, all at no additional cost to the Owner.
B. Prior to Final Inspection....Upon completion of this portion of the work, visually inspect all surfaces and remove all paint and traces of paint from surfaces not scheduled to be painted.

3.9 PAINTING SCHEDULE

------------

Apply the following finishes to the areas designated:

<table>
<thead>
<tr>
<th>Surfaces to be Painted</th>
<th>Painting System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exterior</strong></td>
<td></td>
</tr>
<tr>
<td>Metal Doors and Frames (Exterior &amp; Interior Surfaces)</td>
<td>1st Coat: Pratt and Lambert, Alkyd, Effecto Primer</td>
</tr>
<tr>
<td>Flashing</td>
<td>2nd and 3rd Coat: Pratt and Lambert Alkyd, Gloss, Effecto Enamel, Color Black</td>
</tr>
<tr>
<td>Vent Pipes and Anchors</td>
<td></td>
</tr>
<tr>
<td>Structural Steel</td>
<td></td>
</tr>
<tr>
<td>Handrails</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Metals</td>
<td></td>
</tr>
<tr>
<td>Outlet Works Pipes and Valves</td>
<td>1st Coat: Shop Prime</td>
</tr>
<tr>
<td></td>
<td>2nd and 3rd Coat: Coat Epoxy-Poly-mide, Semi-Gloss 66 Epoxiline</td>
</tr>
<tr>
<td>Trash Rack</td>
<td></td>
</tr>
<tr>
<td>Galvanized Panels</td>
<td>1st Coat: Pratt and Lambert, Galvan-</td>
</tr>
<tr>
<td>Galvanized Sheet Metal</td>
<td>ized Metal Latex Primer</td>
</tr>
<tr>
<td></td>
<td>2nd and 3rd Coat: Pratt and Lambert Alkyd, Effecto Enamel, Color Serendipity for Panels and Gaging Station, White elsewhere.</td>
</tr>
<tr>
<td>Structural Steel for Cableway</td>
<td>1st Coat: Pratt and Lambert Alkyd, Effecto Primer</td>
</tr>
<tr>
<td></td>
<td>2nd and 3rd Coat: Pratt and Lambert Alkyd, Effecto Enamel, Color Serendipity for Panels and Gaging Station, White elsewhere.</td>
</tr>
</tbody>
</table>

9B-5
<table>
<thead>
<tr>
<th>Surfaces to be Painted</th>
<th>Painting System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interior</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>1st Coat: Pratt and Lambert, Epoxy-Hipac, Gloss, Vapex Wall Primer, Color White</td>
</tr>
<tr>
<td>Galvanized Sheet Metal</td>
<td>1st and 2nd Coat: Pratt and Lambert, Epoxy-Hipac, Gloss, Palgard Epoxy Coating, Color White</td>
</tr>
<tr>
<td>Wood</td>
<td>1st and 2nd Coat: Pratt and Lambert, Vinyl Acrylic, Pro-hide House Paint, Color White</td>
</tr>
</tbody>
</table>

End of Section
SECTION 10A - 48-INCH CONE VALVES WITH ELECTRIC OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....This section includes the two 48-inch cone valves, complete with electric operators, specified control and monitoring devices, and any additional items required for proper installation, control, and monitoring of the 48-inch cone valves. All above mentioned items shall be furnished by the Contractor and installed in the Control Building as shown on the drawings and as specified herein.

B. Related Work Described Elsewhere.....The electrical work required for the control and monitoring of the cone valves shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source.....All items in this section shall be furnished and coordinated by the manufacturer of the 48-inch cone valves.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.5 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacements.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 48-INCH CONE VALVES

A. General.....Each cone valve shall consist essentially of three main parts:

1. The conical closing element referred to as the plug, shall be the principal moving element within the valve body or line. The plug shall
have a full unobstructed waterway equal to the diameter of the body and adjacent piping.

2. The valve body shall have a full unobstructed circular inlet and outlet equal to the diameter of the specified size of valve and adjacent piping.

3. The valve head shall be so designed that it will totally enclose the large diameter of the valve body and support the valve operating mechanism.

The 48-inch cone valves shall be as manufactured by Allis-Chalmers Co. # "Rotovalve", or Owner approved equal. The valves shall be complete with the body, plug, head, and operating and driving mechanism, plus any additional piping or fittings required to operate the valves.

B. Valve Operating Conditions....The valves shall have the capability to operate under the following sets of conditions.

1. Upstream Conditions - 0 PSI to 133 PSI at inlet centerline.

2. Downstream Conditions - 0 PSI to 133 PSI at outlet centerline.

3. Capable of opening with full reservoir head at inlet centerline (133 PSI) and free discharge at outlet centerline (0 PSI).

4. Capable of closing with full reservoir head at inlet at centerline (133 PSI) and free discharge at outlet centerline (0 PSI).

5. The valve shall be installed with the horizontal pipe, vertical plug axis orientation.

C. Operating Mechanism -

1. The operating mechanism shall consist of a lifter lever to perform lifting and seating functions through a threaded lift nut and a rotator lever attached to the plug shaft, which shall impart a rotary motion to the plug. Linkage or other connection shall connect these to a crosshead, which moves in a straight line, using guide rods, and operates the two functional levers described above. In this way, the crosshead acting in a straight line imparts the proper movement to the levers in order to perform the operating function of the cone valve.

2. The operating mechanism cover shall make a registered connection with the mechanism housing and be provided with a bronze sleeve bearing to support the outer end of the plug shaft. An indicator plate shall be provided on this cover and an indicator attached to the outer end of the plug shaft, which will at all times indicate the position of the plug opening with respect to the opening of the body.

3. The operating mechanism shall be a self-contained unit, attached to the plug shaft by a readily accessible disconnect coupling.
D. Operation of the Valve -

1. The operation of the cone valve shall employ an axial motion to lift the plug from its seat, followed by a rotary movement of the plug to open the valve combined with a gradual axial movement at the open end of the stroke to reseat the plug in the open position. The closing movement of the valve plug shall be in the reverse order.

2. As previously described, all of the above motions shall be accomplished by moving a crosshead in a straight line. The power for moving the crosshead is supplied by an electric motor operator which, when energized, turns a threaded screw engaging a similar thread in the crosshead. The motor operator shall be adequately sized to operate the cone valve with a full hydraulic unbalance across the valve equal to the maximum working pressure. The motor operator shall be provided with a handwheel so arranged to permit manual operation of the cone valve in an emergency.

E. Construction of the Valve -

1. Each cone valve covered by these specifications shall be adequately designed to operate under maximum working pressure of 133 psi gauge. The operating mechanism, however, shall be constructed for 250 psi gauge maximum working pressure and shall be designed to permit adjustment of seating.

2. The inlet and outlet part of the cone valve body shall be provided with seat rings of monel metal electrically fused into the body material and sufficiently raised above the internal surface of the body to assure free operation. The waterway flanges of the body shall be as previously specified. The large diameter of the body cone shall be flanged to accommodate the valve head, which shall make a registered connection with the valve body.

3. The plug shall be provided with four (4) sets of raised monel seat rings, electrically fused into the plug material, one each for the inlet and outlet around the plug openings - the other two at right angles, so as to seat tightly and cut off the flow when the valve is closed.

4. The upper and lower plug trunnions shall be cast integrally with the valve plug. These trunnions and the pivot bearings in the body and head shall be bronze bushed and designed to take the full maximum bearing loads possible for the operating conditions specified. The maximum allowable pressure on the projected area of the trunnion bearings shall not exceed 3000 pounds per square inch.

5. The plug shaft shall be fastened to the plug by means of a pinned connection and shall be adequately designed to withstand all tensile, torsional and combined stresses imposed upon it. It shall be hard bronze bushed or hard chrome overlaid where it passes through the stuffing box in the valve head.

6. Packing for all stuffing boxes shall be adequate and deep, generally of the Garlock square type suitable for the service to which it is applied.
2.2 ELECTRIC OPERATOR

A. General. Electric operator shall include the electric motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, declutch lever, opening and closing contactors with overload relays, mechanical interlocks, internal wiring with terminal blocks for external connections, control transformer, limit switch compartment condensation heater, position transmitter, mechanical position indicator, and handwheel as a self-contained unit.

B. Operating Conditions

1. Approximate rate of travel shall be 3" per minute. It shall take 16 minutes minimum to operate the valve from the fully opened to the fully closed position or from the fully closed to the fully opened position.

2. Ambient temperature range 33°F to 80°F.

3. Operator shall be mounted integrally with the valve and shall be of sufficient size to properly operate the valve under all flow conditions specified herein.

4. Operator shall hold the valve in any intermediate position between full-open and full closed without creeping or fluttering.

5. Maximum motor horsepower shall be 15HP.

C. Electric Operator Components

1. Power Gearing. All reduction gearing shall consist of generated helical gears, a combination of spur and worm gearing. All gearing shall be of alloy steel, heat treated except worm gears which shall be of gear bronze suitable for the specific rubbing velocity. Gearing shall be lubricated and mounted on anti-friction bearings throughout. Ratio combinations shall be such to simplify changes if needed. Power gearing and enclosure shall permit use of a lubricant suitable for ambient temperature specified above.

2. Handwheels. An integral handwheel shall be provided for manual operation. The handwheel shall not rotate during electric motor operation and during manual operation the motor shall not be turned. The motor shall not interfere with manual operation. The unit shall be responsive to electrical or manual control at all times, electric control having precedence over manual control. Means shall be provided to shift from electric power operation to manual operation in the event of electric malfunctions.

3. Limit Switches. Operator shall be equipped with four (4) train geared limit switches capable of being set to trip over the full range of valve travel from open to close. Limit switch gearing shall be of the intermittent type of stainless steel or bronze in step at all times with the driving mechanism whether in electric or manual operation mode, used for signal purposes only when in the manual operation mode. Contacts shall be of the direct action or snap action type with interchangeable...
4. Torque Switches.... The operator shall be equipped with double mechanical torque switches. Torque switches shall be responsive to load encountered during full travel in the opening or closing direction and shall be adjustable to provide protection to the valve and operator should an overload develop. Each torque switch shall have one normally closed contact of the direct action or snap action type and shall function without auxiliary relays or devices.

5. Motor and Internal Controls..... Motor shall be specifically designed for constant speed open-close operation. Motor shall function integral to operator to provide the valve rate of travel specified above.

The motor shall be high torque with permanently lubricated ball bearings and shall meet or exceed the following design parameters:

- Ambient Temperature: 40°C
- Service Factor: 1.0 @ 6,450 feet
- Enclosure: Totally enclosed fan cooled (TEFC)
- Windings: Copper
- Insulation Class: B
- Voltage/Phase/Frequency: 480V/3 Phase/60 Hz

Locked rotor current all motors 3/4 HP and larger shall not exceed that listed for NEMA Locked Rotor Indicating Code Letter H, (6.30-7.09 kVA/HP).

The operator shall include opening and closing contactors, with operating coils rated for operation on 120 VAC and thermal overload protection (automatic reset type) sized for the motor furnished. The operator shall be prewired including limit switch and torque switch interlocks. All external wiring terminations shall be made through terminal blocks. The terminal blocks shall contain wiring from the spare limit switch contacts which are not internally connected. All terminal blocks shall be clearly marked as to function. The 120 VAC control source shall be internally derived from an integral control transformer with fused primary and secondary circuits. The operator control shall have provisions for remote open-close control as indicated on the drawings.

6. Position Potentiometer..... Potentiometer for position only shall have a maximum resistance of 1,000 OHMS ±10%, 1 watt or greater; its resolution shall be better than 0.5 percent with an active range 50 percent or greater of total resistance. Temperature coefficient shall be 100 PPM/degrees F, linearity of 5 percent. Potentiometer shall be direct coupled to the mechanical dial position indicator gearing. The use of belts or chains shall not be permitted for potentiometer coupling.

7. Position Transmitter..... The position transmitter shall convert the potentiometer resistance to a 4-20mA DC signal linearly proportional to the valve's position, 0-100 percent open. The signal transmitter shall be capable of driving a minimum load of 500 ohms and shall be powered by the internal control source.
8. Enclosure For Electrical Equipment....Enclosure housing the limit switches, torque switches, control contactors, control transformer, potentiometer, position transmitter, etc. shall be rated NEMA 4 (minimum) and shall contain a thermostatically controlled condensation heater connected to the control transformer. If a separate enclosure is provided for the limit switches, it shall also contain a thermostatically controlled condensation heater.

9. Mechanical Dial Position Indicator.....The operator shall contain a gear driven mechanical dial type position indicator which will display the valve's position, 0-100 percent open. The position indicator shall be oriented such that it is visible from the local operator station and shall be a minimum of 4" diameter.

2.3 SURFACE PREPARATION AND PRIME
--------------------------
A. Surface Preparation.....Surface preparation shall be steel structures painting council specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 chem-prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.

PART 3 - EXECUTION
----------------------------------
3.1 INSTALLATION
------------------
Installation shall be in accordance with manufacturer's recommendations and as directed by the Owner. A manufacturer's representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptable as determined by the Owner.

3.2 CONTROLS
----------
The electrically operated valve shall be locally controlled from the main control panel and remotely controlled via VHF radio communications. The Contractor shall coordinate the fabrication of the local control panel to insure compatibility with the equipment specified in this section. Control panels shall be as specified in Division 16.

Any field modifications for the interconnection of the control panels and the electric operator shall be performed by the Contractor following approval by the Owner.

3.3 TESTING
----------
A. Shop Testing.....The cone valve body and head shall be hydrostatically tested for a period of 4 hours at a test pressure of 1-1/2 times the maximum working pressure (200 psi) for which the valve is intended. Under this test the parts shall show no evidence of distress and shall be free from any leaks or weeping. When fully shop assembled, each cone valve shall be submitted to the following leakage test--
With the valve in the closed position and the seats under the maximum working pressure there shall be no leakage.

The cone valve, when fully shop assembled, shall be given at least two (2) operations (operating the valve from fully closed to fully open and from fully open to fully closed shall constitute one operation). The valve and its respective controls shall be operated as a unit to test the function of the control.

Test records and results of the shop tests shall be forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests –

1. General.....Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

2. Overall Performance Test.....Testing of the cone valve’s overall performance shall consist of operating the valve throughout its entire range of travel.

Movement of the valve shall occur in a smooth, uninterrupted fashion with all indicators, limit switches, and torque switches working and calibrated properly. The Contractor shall be responsible for all adjustments, repairs, or replacements required to operate the system as prescribed.

3. Hydrostatic Test.....Field hydrostatic tests shall be performed on the cone valve in conjunction with the intermediate piping. Test pressure shall be 200 PSI for 4 hours. There shall be no leakage during the test period.

End of Section
SECTION 10B - 42-INCH FIXED-CONE DISPERSION VALVES WITH ELECTRICAL OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....This section includes the two fixed-cone dispersion valves complete with electric operators, specified control and monitoring devices, valve steel hood, and any additional items required for the proper installation, control, and monitoring of the fixed-cone dispersion valves. All above mentioned items shall be furnished by the Contractor and installed in the control building as shown on the drawings and as specified herein.

B. Related Work Described Elsewhere.....The electrical work required for control and monitoring of the 42-inch fixed-cone dispersion valves shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specification such as ASTM, AWWA, IEEE, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source.....All items in this section, including the valve steel hood, shall be furnished and coordinated by the manufacturer of the fixed-cone dispersion valves.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.0D of these specifications. Computations of sufficient detail to insure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacements.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 42-INCH FIXED-CONE DISPERSION VALVES

A. General.....The fixed-cone dispersion valves shall be as manufactured by
Allis-Chalmers Co. Howell-Bunger valves, or Owner approved equal. The valves shall be complete with the body, a cylinder gate which operates over the valve ports, seals, the operating and driving mechanism, valve steel hood, plus any additional piping or fittings required to operate the valves.

B. Valve Operating Conditions.....The valves shall have the capability to operate under the following sets of conditions.

1. The valve shall be operated from 10% open to the 100% fully opened position.

2. Upstream Pressure - 133 PSI at inlet centerline.
   Required Discharge - 0 to 1000 CPS.

3. Upstream Pressure - 15 PSI at inlet centerline.
   Required Discharge - 0 to 350 CPS.

4. Downstream Pressure - Atmospheric pressure at outlet centerline at all required discharges.

C. Body.....The body shall consist of a cylinder with a flange on the upstream end for bolting to the 42-inch steel pipe, an inverted cone-shaped head on the downstream end, and internal radial ribs. The valve shall contain a minimum of 4 radial ribs, and the ribs shall have a minimum 1.00" thickness. The radial ribs shall extend beyond the downstream end of the cylinder shell through the valve ports to the cone-shaped head. A stainless steel sleeve on the valve body and stainless steel facing on the edges of the radial ribs along the discharge ports over which the cylinder gate slides shall be provided. The valve body shall be fabricated from steel plate and stress relieved before machining.

D. Gate and Seals.....The cylinder gate shall slide upstream over the sleeve on the body to open, and shall slide downstream over the valve ports to close. The downstream end of the cylinder gate shall have a stainless steel (E-309) seal welded on in a continuous circle. This seal shall be machined to securely seat against a steel seat ring which shall have a welded, beveled stainless steel (E-308) contact surface. The seat ring shall be attached to the downstream end of the body with bolts and a suitable gasket. The upstream end of the cylinder gate shall be counter-bored to receive a u-shaped packing between it and the body sleeve, creating an efficient seal for any position of the gate. This packing shall be held in place by a retaining ring. Bearing pads, of welded bronze overlay, shall be located at each end of the gate inside diameter in line with the body ribs. The cylinder gate shall be fabricated from steel plate and stress relieved before machining.

D. Operating Mechanism.....The screw type operating mechanism shall consist of:

1. 2 bronze nuts with machined threads, equipped for grease lubrication.
2. 2 bronze screw stems with machined threads for a close running-fit in the bronze nuts.

3. 2 steel pipe covers for the screw stems.

4. 2 worm or bevel gear reducers, grease-lubricated, with cast iron housings, cast iron covers, solid bronze worm wheels with machine-cut teeth, machine-cut worms of hardened and ground steel or machine-cut bevel gears, heavy-duty thrust bearings, and grease seals.

5. 1 miter gear box, grease lubricated, with cast iron housing, machine-cut steel miter gears, ball thrust bearings, bronze shaft bushings, and grease seals, steel shafts and couplings.

E. Connections......The 42-inch fixed-cone dispersion valves shall be furnished with a 42-inch AWWA Class E flange for connection to the piping.

F. The 42-inch diameter fixed-cone dispersion valves shall be furnished with a 1/2-inch thick steel hood, with a removable hatch for access from the control building to the valve area, as shown on the Drawings. The exact dimensions of this hood shall be as recommended by the valve manufacturer. This hood shall be supplied with 5/8" x 6" welded stud anchors at 4'-0" on centers each way (staggered) as shown on the Drawings, and shall be supplied with an interior lining of coal tar epoxy in accordance with AWWA C210.

2.2 ELECTRIC OPERATOR

A. General......Electric operator shall include the electric motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, declutch lever, opening and closing contactors with overload relays, mechanical interlocks, internal wiring with terminal blocks for external connections, control transformer, limit switch compartment condensation heater, position transmitter, mechanical position indicator, and handwheel as a self-contained unit.

B. Operating Conditions -

1. Approximate rate of travel shall be 3" per minute. It shall take 14 minutes minimum to operate the valve from the fully opened to the fully closed position or from the fully closed to the fully opened position.

2. Ambient temperature range 33°F to 80°F.

3. Operator shall be mounted integrally with the valve and shall be of sufficient size to properly operate the valve under all flow conditions specified herein.

4. Operator shall hold the valve in any intermediate position between full-open and full closed without creeping or fluttering.

5. Maximum motor horsepower shall be 10HP.
C. Electric Operator Components

1. Power Gearing.....All reduction gearing shall consist of generated helical gears, a combination of spur and worm gearing. All gearing shall be of alloy steel, heat treated except worm gears which shall be of gear bronze suitable for the specific rubbing velocity. Gearing shall be lubricated and mounted on anti-friction bearings throughout. Ratio combinations shall be such to simplify changes if needed. Power gearing and enclosure shall permit use of a lubricant suitable for ambient temperature specified above.

2. Bandwheels.....An integral handwheel shall be provided for manual operation. The handwheel shall not rotate during electric motor operation and during manual operation the motor shall not be turned. The motor shall not interfere with manual operation. The unit shall be responsive to electrical or manual control at all times, electric control having precedence over manual control. Means shall be provided to shift from electric power operation to manual operation in the event of electric malfunctions.

3. Limit Switches.....Operator shall be equipped with four (4) train geared limit switches capable of being set to trip over the full range of valve travel from open to close. Limit switch gearing shall be of the intermittent type of stainless steel or bronze in step at all times with the driving mechanism whether in electric or manual operation mode, used for signal purposes only when in the manual operation mode. Contacts shall be of the direct action or snap action type with interchangeable switch elements. Contacts shall be rated 120 VAC, 5 amps.

4. Torque Switches.....The operator shall be equipped with double mechanical torque switches. Torque switches shall be responsive to load encountered during full travel in the opening or closing direction and shall be adjustable to provide protection to the valve and operator should an overload develop. Each torque switch shall have one normally closed contact of the direct action or snap action type and shall function without auxiliary relays or devices.

5. Motor and Internal Controls.....Motor shall be specifically designed for constant speed open-close operation. Motor shall function integral to operator to provide the valve rate of travel specified above.

The motor shall be high torque with permanently lubricated ball bearings and shall meet or exceed the following design parameters:

Ambient Temperature: 40°C
Service Factor: 1.0 @ 6,450 feet
Enclosure: Totally enclosed fan cooled (TEFC)
Windings: Copper
Insulation Class: B
Voltage/Phase/Frequency: 480V/3 Phase/60 Hz

Locked rotor current all motors 3/4 HP and larger shall not exceed that listed for NEMA Locked Rotor Indicating Code Letter H, (6.30-7.09
The operator shall include opening and closing contactors, with operating coils rated for operation on 120 VAC and thermal overload protection (automatic reset type) sized for the motor furnished. The operator shall be prewired including limit switch and torque switch interlocks. All external wiring terminations shall be made through terminal blocks. The terminal blocks shall contain wiring from the spare limit switch contacts which are not internally connected. All terminal blocks shall be clearly marked as to function. The 120 VAC control source shall be internally derived from an integral control transformer with fused primary and secondary circuits. The operator control shall have provisions for remote open-close control as indicated on the drawings.

6. Position Potentiometer.....Potentiometer for position only shall have a maximum resistance of 1,000 OHMS +10%, 1 watt or greater; its resolution shall be better than 0.5 percent with an active range 50 percent or greater of total resistance. Temperature coefficient shall be 100 PPM/degrees F, linearity of 5 percent. Potentiometer shall be direct coupled to the mechanical dial position indicator gearing. The use of belts or chains shall not be permitted for potentiometer coupling.

7. Position Transmitter.....The position transmitter shall convert the potentiometer resistance to a 4-20mA DC signal linearly proportional to the valve's position, 0-100 percent open. The signal transmitter shall be capable of driving a minimum load of 500 ohms and shall be powered by the internal control source.

8. Enclosure For Electrical Equipment.....Enclosure housing the limit switches, torque switches, control contactors, control transformer, potentiometer, position transmitter, etc. shall be rated NEMA 4 (minimum) and shall contain a thermostatically controlled condensation heater connected to the control transformer. If a separate enclosure is provided for the limit switches, it shall also contain a thermostatically controlled condensation heater.

9. Mechanical Dial Position Indicator.....The operator shall contain a gear driven mechanical dial type position indicator which will display the valve's position, 0-100 percent open. The position indicator shall be oriented such that it is visible from the local operator station and shall be a minimum of 4" diameter.

2.3 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 chem-prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.
PART 3 - EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturer's recommendations and as directed by the Owner. A manufacturer's representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptable as determined by the Owner.

3.2 CONTROLS

The electrically operated valve shall be locally controlled from the main control panel and remotely controlled via VHF radio communications. The Contractor shall coordinate the fabrication of the local control panel to insure compatibility with the equipment specified in this section. Control panels shall be as specified in Division 16.

Any field modifications for the interconnection of the control panels and the electric operator shall be performed by the Contractor following approval by the Owner.

3.3 TESTING

A. Shop Tests.....Each valve shall be shop tested at 200 PSI pressure for 4 hours. During this test leakage shall not exceed 1.5 gallons per minute nor 360 gallons for the entire testing period. Test records and results shall be forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming, 82070.

Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

Shop tests on the electric operators shall be performed in conjunction with the fixed-cone dispersion valve with test records and results being forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming, 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests -

1. General.....Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.
2. Overall Performance Test.....Testing of the fixed-cone dispersion valve's overall performance shall consist of operating the valve throughout its entire range of travel.

Movement of the valve shall occur in a smooth, uninterrupted fashion with all indicators, limit switches, and torque switches working and calibrated properly. The Contractor shall be responsible for all adjustments, repairs, or replacements required to operate the system as prescribed.

3. Hydrostatic Test.....Field hydrostatic tests shall be performed on the gate valve in conjunction with the intermediate piping. Test pressure shall be 200 PSI for 4 hours. Leakage shall not exceed 1.5 gallons per minute nor 360 gallons for the entire testing period.

End of Section
SECTION 10C - 24-INCH ANGLE PATTERN POLYJET VALVES WITH ELECTRIC OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....This section includes the two 24-inch angle pattern polyjet valves complete with electric operators, operator stems, special piping, connectors, fittings, plus any additional items required for the control or monitoring of the angle pattern polyjet valves. All above mentioned items shall be furnished by the Contractor and installed in the control building as shown on the Drawings and as specified herein.

B. Related Work Described Elsewhere.....The electrical work required for control and monitoring of the angle pattern polyjet valves shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specification such as ASTM, AWWA, IEEE, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source.....All items in this section shall be furnished and coordinated by the manufacturer of the angle pattern polyjet valves.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these specifications. Computations of sufficient detail to insure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacements.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 24-INCH ANGLE PATTERN POLYJET VALVES

A. General....The two angle pattern polyjet valves shall be 24" Bailey Polyjet Valve Model 812 angle pattern valves as manufactured by the Charles M. Bailey Co., or Owner approved equal. The valves shall be complete with valve stem, connectors, plus any additional piping or
fittings required to operate the valves.

B. Valve Operating Conditions.....The valves shall have the capability to operate under the following sets of conditions.

1. Upstream Pressure - From 22 PSI to 133 PSI at inlet centerline. Required Discharge - From 0 CPS to 100 CPS. Downstream Pressure - 2.2 PSI at outlet centerline.

C. Connections.....The valve shall be furnished with 24-inch AWWA Class E for connection to the piping flanges as shown on the Drawings.

D. Pressure and Air-Vacuum Valve Outlets.....The valve shall be furnished with 1 inch and 1/2 inch threaded outlets for a pressure gage and an air-vacuum valve. Outlets shall be reinforced tapped outlets in conformance with AWWA M11-steel pipe manual.

2.2 ELECTRIC OPERATOR

A. General.....Electric operator shall include the electric motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, declutch lever, opening and closing contactors with overload relays, mechanical interlocks, internal wiring with terminal blocks for external connections, control transformer, limit switch compartment condensation heater, position transmitter, mechanical position indicator, and handwheel as a self-contained unit.

B. Operating Conditions -

1. Approximate rate of travel shall be 3" per minute. It shall take 8 minutes minimum to operate the valve from the fully opened to the fully closed position or from the fully closed to the fully opened position.

2. Ambient temperature range 33°F to 80°F.

3. Operator shall be mounted integrally with the valve and shall be of sufficient size to properly operate the valve under all flow conditions specified herein.

4. Operator shall hold the valve in any intermediate position between full-open and full closed without creeping or fluttering.

5. Maximum motor horsepower shall be 1 1/2HP.

C. Electric Operator Components

1. Power Gearing.....All reduction gearing shall consist of generated helical gears, a combination of spur and worm gearing. All gearing shall be of alloy steel, heat treated except worm gears which shall be of gear bronze suitable for the specific rubbing velocity. Gearing shall be lubricated and mounted on anti-friction bearings throughout. Ratio combinations shall be such to simplify changes if needed. Power gearing and enclosure shall permit use of a lubricant suitable for ambient temperature specified above.
2. Handwheels.....An integral handwheel shall be provided for manual operation. The handwheel shall not rotate during electric motor operation and during manual operation the motor shall not be turned. The motor shall not interfere with manual operation. The unit shall be responsive to electrical or manual control at all times, electric control having precedence over manual control. Means shall be provided to shift from electric power operation to manual operation in the event of electric malfunctions.

3. Limit Switches.....Operator shall be equipped with four (4) train geared limit switches capable of being set to trip over the full range of valve travel from open to close. Limit switch gearing shall be of the intermittent type of stainless steel or bronze in step at all times with the driving mechanism whether in electric or manual operation mode, used for signal purposes only when in the manual operation mode. Contacts shall be of the direct action or snap action type with interchangeable switch elements. Contacts shall be rated 120 VAC, 5 amps.

4. Torque Switches.....The operator shall be equipped with double mechanical torque switches. Torque switches shall be responsive to load encountered during full travel in the opening or closing direction and shall be adjustable to provide protection to the valve and operator should an overload develop. Each torque switch shall have one normally closed contact of the direct action or snap action type and shall function without auxiliary relays or devices.

5. Motor and Internal Controls.....Motor shall be specifically designed for constant speed open-close operation. Motor shall function integral to operator to provide the valve rate of travel specified above.

The motor shall be high torque with permanently lubricated ball bearings and shall meet or exceed the following design parameters:

- Ambient Temperature: 40°C
- Service Factor: 1.0 @ 6,450 feet
- Enclosure: Totally enclosed fan cooled (TEFC)
- Windings: Copper
- Insulation Class: B
- Voltage/Phase/Frequency: 480V/3 Phase/60 Hz

Locked rotor current all motors 3/4 HP and larger shall not exceed that listed for NEMA Locked Rotor Indicating Code Letter H, (6.30-7.09 kVA/HP).

The operator shall include opening and closing contactors, with operating coils rated for operation on 120 VAC and thermal overload protection (automatic reset type) sized for the motor furnished. The operator shall be previred including limit switch and torque switch interlocks. All external wiring terminations shall be made through terminal blocks. The terminal blocks shall contain wiring from the spare limit switch contacts which are not internally connected. All terminal blocks shall be clearly marked as to function. The 120 VAC control source shall be internally derived from an integral control transformer with fused primary and secondary circuits. The operator
control shall have provisions for remote open-close control as indicated on the drawings.

6. Position Potentiometer.....Potentiometer for position only shall have a maximum resistance of 1,000 OHMS +10%, 1 watt or greater; its resolution shall be better than 0.5 percent with an active range 50 percent or greater of total resistance. Temperature coefficient shall be 100 PPM/degrees F, linearity of 5 percent. Potentiometer shall be direct coupled to the mechanical dial position indicator gearing. The use of belts or chains shall not be permitted for potentiometer coupling.

7. Position Transmitter.....The position transmitter shall convert the potentiometer resistance to a 4-20mA DC signal linearly proportional to the valve's position, 0-100 percent open. The signal transmitter shall be capable of driving a minimum load of 500 ohms and shall be powered by the internal control source.

8. Enclosure For Electrical Equipment.....Enclosure housing the limit switches, torque switches, control contactors, control transformer, potentiometer, position transmitter, etc. shall be rated NEMA 4 (minimum) and shall contain a thermostatically controlled condensation heater connected to the control transformer. If a separate enclosure is provided for the limit switches, it shall also contain a thermostatically controlled condensation heater.

9. Mechanical Dial Position Indicator.....The operator shall contain a gear driven mechanical dial type position indicator which will display the valve's position, 0-100 percent open. The position indicator shall be oriented such that it is visible from the local operator station and shall be a minimum of 4" diameter.

2.3 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 chem-prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.

PART 3 - EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturer’s recommendations and as directed by the Owner. A manufacturer’s representative knowledgeable in this type of equipment shall be present at installation and start-up until all items are working acceptably as determined by the Owner.
3.2 CONTROLS

The electrically operated valve shall be locally controlled from the main control panel and remotely controlled via VHF radio communications. The Contractor shall coordinate the fabrication of the local control panel to insure compatibility with the equipment specified in this section. Control panels shall be as specified in Division 16.

Any field modifications for the interconnection of the control panels and the electric operator shall be performed by the Contractor following approval by the Owner.

3.3 TESTING

A. Shop Testing.....The 24" angle pattern polyjet valves shall be hydrostatically tested for a period of 4 hours at a test pressure of 1-1/2 times the maximum working pressure (150 psi) for which the valve is intended. Under this test the parts shall show no evidence of distress and shall be free from any leaks or weeping. When fully shop assembled, each angle pattern valve shall be submitted to the following leakage test:

With the valve in the closed position and the seats under maximum working pressure there shall be no leakage.

The angle pattern polyjet valves, when fully shop assembled, shall be given at least two (2) operations. Each operation shall consist of operating the valve from its fully closed position to the fully open position at 10% increments and reversing the process to the fully closed position. The valve and its respective controls shall be operated as a unit to test the function of the control.

Shop tests on the electric operators shall be performed in conjunction with the polyjet valves with test records and results being forwarded, properly identified to Banner Associates, Inc. P.O. Box 550, Laramie, Wyoming, 82070. Torque switch shall have factory preset to open against full differential head across the valve (0 head downstream) and preset for proper torque seating against full differential upon closing. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed at no additional cost to the Owner.

Test records and records of the shop tests shall be forwarded, properly identified, to Banner Associates, Inc. P.O. Box 550, Laramie, Wyoming 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests -

1. General.....Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in
this section, to determine that equipment, materials, or systems meet all requirements of these Specifications.

All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to the use of unapproved test procedures or due to improper handling of test apparatus.

2. Overall Performance Test.....Testing of the angle pattern polyjet valve's overall performance shall consist of operating the valve throughout its entire range of travel from the control panel in the control building. Each panel shall, in conjunction with the mechanical components, perform all power, indication, and control loop functions as specified, shown on the Drawings, or as otherwise approved by the Owner, and as specified in Division 16.

Movement of the valve shall occur in a smooth, uninterrupted fashion with all indicators, limit switches, and torque switches working and calibrated properly. The Contractor shall be responsible for all adjustments, repairs, or replacements required to operate the system as specified.

3. Hydrostatic Test.....The valves shall be hydrostatically tested at 200 PSI for 4 hours. Leakage shall not exceed 10 gallons for the test period for each valve.

End of Section
SECTION 10D - 30-INCH GATE VALVE WITH ELECTRIC OPERATOR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....This section includes the 30" gate valve, complete with electric operator and specified control and monitoring devices. All above mentioned items shall be furnished by the Contractor and installed in the Control Building as shown on the drawings and as specified herein.

B. Related Work Described Elsewhere.....The electrical work required for the control and monitoring of the gate valve shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source.....All items in this section shall be furnished and coordinated by the manufacturer of the gate valve.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 30-INCH GATE VALVE

A. General.....The 30" gate valve shall be in accordance with AWWA Specification C500 and shall be Dresser M&H Style 67 AWWA gate valve, or Owner approved equal.

B. Valve Operating Characteristics.....The valve shall have the following characteristics.
1. Size - 30-inch.
2. 133 PSI normal working pressure.
3. 200 PSI maximum differential pressure.
5. Non-rising stem.
7. Suitable for operation with electric operator.
8. Body - Cast iron, bronze mounted.
10. Seals - o-ring.
11. Maximum velocity - 21 FPS.

2.2 ELECTRIC OPERATOR

A. General....Electric operator shall include the electric motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, declutch lever, opening and closing contactors with overload relays, mechanical interlocks, internal wiring with terminal blocks for external connections, control transformer, limit switch compartment condensation heater, position transmitter, mechanical position indicator, and handwheel as a self-contained unit.

B. Operating Conditions

1. Approximate rate of travel shall be 3" per minute. It shall take 10 minutes minimum to operate the valve from the fully opened to the fully closed position or from the fully closed to the fully opened position.

2. Ambient temperature range 33°F to 80°F.

3. Operator shall be mounted integrally with the valve and shall be of sufficient size to properly operate the valve under all flow conditions specified herein.

4. Operator shall hold the valve in any intermediate position between full-open and full-closed without creeping or fluttering.

5. Maximum motor horsepower shall be 3.0 HP.

C. Electric Operator Components

1. Power Gearing.....All reduction gearing shall consist of generated helical gears, a combination of spur and worm gearing. All gearing shall be of alloy steel, heat treated except worm gears which shall be of gear bronze suitable for the specific rubbing velocity. Gearing
shall be lubricated and mounted on anti-friction bearings throughout. Ratio combinations shall be such to simplify changes if needed. Power gearing and enclosure shall permit use of a lubricant suitable for ambient temperature specified above.

2. Handwheels.....An integral handwheel shall be provided for manual operation. The handwheel shall not rotate during electric operation and during manual operation the motor shall not be turned. The motor shall not interfere with manual operation. The unit shall be responsive to electrical or manual control at all times, electric control having precedence over manual control. Means shall be provided to shift from electric power operation to manual operation in the event of electric malfunctions.

3. Limit Switches.....Operator shall be equipped with four (4) train geared limit switches capable of being set to trip over the full range of valve travel from open to close. Limit switch gearing shall be of the intermittent type of stainless steel or bronze in step at all times with the driving mechanism whether in electric or manual operation mode, used for signal purposes only when in the manual operation mode. Contacts shall be of the direct action or snap action type with interchangeable switch elements. Contacts shall be rated 120 VAC, 5 AMPS.

4. Torque Switches.....The operator shall be equipped with double mechanical torque switches.Torque switches shall be responsive to load encountered during full travel in the opening or closing direction and shall be adjustable to provide protection to the valve and operator should an overload develop. Each torque switch shall have one normally closed contact of the direct action or snap action type and shall function without auxiliary relays or devices.

5. Motor and Internal Controls....Motor shall be specifically designed for constant speed open-close operation. Motor shall function integral to operator to provide the valve rate of travel specified above.

The motor shall be high torque with permanently lubricated ball bearings and shall meet or exceed the following design parameters:

- Ambient Temperature: 40°C
- Service Factor: 1.0 @ 6,450 feet.
- Enclosure: Totally enclosed fan cooled (TEFC)
- Windings: Copper.
- Insulation Class: B
- Voltage/Phase/Frequency: 480V/3 phase/60 Hz


The operator shall include opening and closing contactors, with operating coils rated for operation on 120 VAC and thermal overload protection (Automatic Reset Type) sized for the motor furnished. The operator shall be prewired including limit switch and torque switch interlocks. All external wiring terminations shall be made through terminal blocks. The terminal blocks shall contain wiring from the
spare limit switch contacts which are not internally connected. All terminal blocks shall be clearly marked as to function. The 120 VAC control source shall be internally derived from an integral control transformer with fused primary and secondary circuits. The operator control shall have provisions for remote open-close control as indicated on the drawings.

6. Position Potentiometer.....Potentiometer for position only shall have a maximum resistance of 1,000 OHMS +10%, 1 watt or greater; its resolution shall be better than 0.5 percent with an active range 50 percent or greater of total resistance. Temperature coefficient shall be 100 PPM/degrees F, linearity of 5 percent. Potentiometer shall be direct coupled to the mechanical dial position indicator gearing. The use of belts or chains shall not be permitted for potentiometer coupling.

7. Position Transmitter.....The position transmitter shall convert the potentiometer resistance to a 4-20mA DC signal linearity proportional to the valve's position, 0-100 percent open. The signal transmitter shall be capable of driving a minimum load of 500 OHMS and shall be powered by the internal control source.

8. Enclosures for Electrical Equipment.....Enclosure housing the limit switches, torque switches, control contactors, control transformer, potentiometer, position transmitter, etc. shall be rated NEMA 4 (minimum) and shall contain a thermostatically controlled condensation heater connected to the control transformer. If a separate enclosure is provided for the limit switches, it shall also contain a thermostatically controlled condensation heater.

9. Mechanical Dial Position Indicator.....The operator shall contain a gear driven mechanical dial type position indicator which will display the valve's position, 0-100 percent open. The position indicator shall be oriented such that it is visible from the local operator station and shall be a minimum of 4" diameter.

2.3 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 Chem-Prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.

PART 3 - EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturer's recommendations and as directed by the Owner. A manufacturer's representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptable as determined by the Owner.
3.2 CONTROLS

The electrically operated valve shall be locally controlled from the Main Control Panel and remotely controlled via VHF radio communications. The Contractor shall coordinate the fabrication of the local control panel to ensure compatibility with the equipment specified in this section. Control panels shall be as specified in Division 16.

Any field modifications for the interconnection of the control panels and the electric operator shall be performed by the Contractor following approval by the Owner.

3.3 TESTING

A. Shop Tests

••••• Shop tests on the valve shall be performed in accordance with Section 5 of AWWA Specifications C500 with test records and results being forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming, 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

Shop tests on the electric operators shall be performed in conjunction with the gate valve with test records and results being forwarded, properly identified to Banner Associates, Inc. P.O. Box 550, Laramie, Wyoming, 82070. Torque switch shall be factory preset to open against full differential head across the valve (0 head downstream) and preset for proper torque seating against full differential upon closing. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests

1. General

••••• Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

2. Overall Performance Test

••••• Testing of the gate valve’s overall performance shall consist of operating the valve throughout its entire range of travel.

Movement of the valve shall occur in a smooth, uninterrupted fashion with all indicators, limit switches, and torque switches working and calibrated properly. The Contractor shall be responsible for all adjustments, repairs, or replacements required to operate the system as prescribed.
3. Hydrostatic Test.....Field hydrostatic tests shall be performed on the gate valve in conjunction with the intermediate piping. Test pressure shall be 200 PSI for 4 hours with a maximum leakage rate of 30 fl.oz/hr.

End of Section
SECTION 10E - 36-INCH GATE VALVES WITH ELECTRIC OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included. ... This section includes the two 36" gate valves, complete with electric operator and specified control and monitoring devices. All above mentioned items shall be furnished by the Contractor and installed in the control building as shown on the drawings and as specified herein.

B. Related Work Described Elsewhere. ... The electrical work required for the control and monitoring of the gate valves shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment. ... All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source. ... All items in this section shall be furnished and coordinated by the manufacturer of the gate valves.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.0 of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection. ... All means necessary will be used to protect materials, before, during, and after installation.

B. Replacement. ... In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 36-INCH GATE VALVE

A. General. ... The 36" gate valve shall be in accordance with AWWA Specification C500 and shall be Dresser M&H Style 67 AWWA gate valve, or Owner approved equal.

B. Valve Operating Characteristics. ... The valve shall have the following characteristics.
1. Size - 36-inch.

2. 133 PSI normal working pressure.

3. 200 PSI maximum differential pressure.


5. Non-rising stem.


7. Suitable for operation with electric operator.

8. Body - Cast iron, bronze mounted.


10. Seals - o-ring.

11. Maximum velocity - 20 FPS.

2.2 ELECTRIC OPERATOR

A. General....Electric operator shall include the electric motor, operator unit gearing, limit switch gearing, limit switches, torque switches, stem nut, declutch lever, opening and closing contactors with overload relays, mechanical interlocks, internal wiring with terminal blocks for external connections, control transformer, limit switch compartment condensation heater, position transmitter, mechanical position indicator, and handwheel as a self-contained unit.

B. Operating Conditions

1. Approximate rate of travel shall be 3" per minute. It shall take 12 minutes minimum to operate the valve from the fully opened to the fully closed position or from the fully closed to the fully opened position.

2. Ambient temperature range 33°F to 80°F.

3. Operator shall be mounted integrally with the valve and shall be of sufficient size to properly operate the valve under all flow conditions specified herein.

4. Operator shall hold the valve in any intermediate position between full open and full closed without creeping or fluttering.

5. Maximum motor horsepower shall be 5.0 HP.

C. Electric Operator Components

1. Power Gearing.....All reduction gearing shall consist of generated helical gears, a combination of spur and worm gearing. All gearing shall be of alloy steel, heat treated except worm gears which shall be
of gear bronze suitable for the specific rubbing velocity. Gearing shall be lubricated and mounted on anti-friction bearings throughout. Ratio combinations shall be such to simplify changes if needed. Power gearing and enclosure shall permit use of a lubricant suitable for ambient temperature specified above.

2. Handwheels....An integral handwheel shall be provided for manual operation. The handwheel shall not rotate during electric motor operation an during manual operation the motor shall not be turned. The motor shall not interfere with manual operation. The unit shall be responsive to electrical or manual control at all times, electric control having precedence over manual control. Means shall be provided to shift from electric power operation to manual operation in the event of electric malfunctions.

3. Limit Switches.....Operator shall be equipped with four (4) train geared limit switches capable of being set to trip over the full range of valve travel from open to close. Limit switch gearing shall be of the intermittent type of stainless steel or bronze in step at all times with the driving mechanism whether in electric or manual operation mode, used for signal purposes only when in the manual operation mode. Contacts shall be of the direct action or snap action type with interchangeable switch elements. Contacts shall be rated 120 VAC, 5 AMPS.

4. Torque Switches.....The operator shall be equipped with double mechanical torque switches. Torque switches shall be responsive to load encountered during full travel in the opening or closing direction and shall be adjustable to provide protection to the valve and operator should an overload develop. Each torque switch shall have one normally closed contact of the direct action or snap action type and shall function without auxiliary relays or devices.

5. Motor and Internal Controls....Motor shall be specifically designed for constant speed open-close operation. Motor shall function integral to operator to provide the valve rate of travel specified above.

The motor shall be high torque with permanently lubricated ball bearings and shall meet or exceed the following design parameters:

- Ambient Temperature: 40°C
- Service Factor: 1.0 @ 6,450 feet.
- Enclosure: Totally enclosed fan cooled (TEFC)
- Windings: Copper.
- Insulation Class: B
- Voltage/Phase/Frequency: 480V/3 phase/60 Hz


The operator shall include opening and closing contactors, with operating coils rated for operation on 120 VAC and thermal overload protection (Automatic Reset Type) sized for the motor furnished. The operator shall be prewired including limit switch and torque switch
interlocks. All external wiring terminations shall be made through terminal blocks. The terminal blocks shall contain wiring from the spare limit switch contacts which are not internally connected. All terminal blocks shall be clearly marked as to function. The 120 VAC control source shall be internally derived from an integral control transformer with fused primary and secondary circuits. The operator control shall have provisions for remote open-close control as indicated on the drawings.

6. Position Potentiometer.....Potentiometer for position only shall have a maximum resistance of 1,000 OHMS ±10%, 1 watt or greater; its resolution shall be better than 0.5 percent with an active range 50 percent or greater of total resistance. Temperature coefficient shall be 100 PPM/degrees F, linearity of 5 percent. Potentiometer shall be direct coupled to the mechanical dial position indicator gearing. The use of belts or chains shall not be permitted for potentiometer coupling.

7. Position Transmitter.....The position transmitter shall convert the potentiometer resistance to a 4-20mA DC signal linearity proportional to the valve’s position, 0-100 percent open. The signal transmitter shall be capable of driving a minimum load of 500 OHMS and shall be powered by the internal control source.

8. Enclosures for Electrical Equipment.....Enclosure housing the limit switches, torque switches, control contactors, control transformer, potentiometer, position transmitter, etc. shall be rated NEMA 4 (minimum) and shall contain a thermostatically controlled condensation heater connected to the control transformer. If a separate enclosure is provided for the limit switches, it shall also contain a thermostatically controlled condensation heater.

9. Mechanical Dial Position Indicator.....The operator shall contain a gear driven mechanical dial type position indicator which will display the valve’s position, 0-100 percent open. The position indicator shall be oriented such that it is visible from the local operator station and shall be a minimum of 4" diameter.

2.3 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 chem-prime as manufactured by TNEMEC company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9 Section 9B.

PART 3 - EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturer’s recommendations
and as directed by the Owner. A manufacturer’s representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptable as determined by the Owner.

3.2 CONTROLS

The electrically operated valve shall be locally controlled from the Main Control Panel and remotely controlled via VHF radio communications. The Contractor shall coordinate the fabrication of the local control panel to ensure compatibility with the equipment specified in this section. Control panels shall be as specified in Division 16.

Any field modifications for the interconnection of the control panels and the electric operator shall be performed by the Contractor following approval by the Owner.

3.3 TESTING

A. Shop Tests.....Shop tests on the valve shall be performed in accordance with Section 5 of AWWA Specifications C500 with test records and results being forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming, 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

Shop tests on the electric operators shall be performed in conjunction with the gate valve with test records and results being forwarded, properly identified to Banner Associates, Inc. P.O. Box 550, Laramie, Wyoming, 82070. Torque switch shall be factory preset to open against full differential head across the valve (0 head downstream) and preset for proper torque seating against full differential upon closing. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests –

1. General.....Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

2. Overall Performance Test.....Testing of the gate valve’s overall performance shall consist of operating the valve throughout its entire range of travel.

Movement of the valve shall occur in a smooth, uninterrupted fashion.
with all indicators, limit switches, and torque switches working and calibrated properly. The Contractor shall be responsible for all adjustments, repairs, or replacements required to operate the system as prescribed.

3. Hydrostatic Test.....Field hydrostatic tests shall be performed on the gate valve in conjunction with the gate valves and intermediate piping. Test pressure shall be 200 PSI for 4 hours with a maximum leakage rate of 36 Fl. Oz./Hr.

End Of Section
SECTION 10F - 36-INCH VENTURI TUBES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....This section includes the two 36" venturi tubes complete with specified flow transmitter, valving, etc. All above mentioned items shall be furnished by the Contractor and installed in the Control Building as shown on the Drawings and as specified herein.

B. Related Work Described Elsewhere.....The electrical work required for monitoring and display of the venturi tube flow shall be as specified in Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEHA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source.....All items in this section shall be furnished and coordinated by the manufacturer of the venturi tube.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these Specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

C. Electronic Transmitter.....The transmitters shall be stored in controlled temperature location prior to installation.

PART 2 - PRODUCTS

2.1 CONDITIONS

A. Each venturi tube and electronic transmitter combination shall produce a linear 4-20 milliamp DC signal proportional to flow rate, accurate to +1% of actual flow, over the entire flow range and under the conditions listed below.
1. Pipeline Size.....36-inch diameter.

2. Minimum Flow.....6 cubic foot per second (CFS).

3. Maximum Flow.....100 cubic feet per second (CFS).

4. Maximum High Water Elevation.....6718.00'.

5. Normal High Water Elevation.....6698.00'.

6. Minimum Water Elevation.....6500.00'.

7. All water elevations between minimum water elevation 6500.00 and maximum water elevation 6718.00.

8. Centerline Elevation of Venturi Tube Inlet.....6450.00'.

9. Media.....Clean water at 33°F.

2.2 36-INCH VENTURI TUBE

A. General.....The 36-inch venturi tubes shall be BIF Model UVTC 1-0180 or approved equal. The meter shall be furnished with flanges compatible with ANSI B16.1, Class 250 flanges.

B. Meters.....The metering primary shall be of the pressure differential producing type utilizing pure static pressure sensed at the inlet and throat sections.

The inlet section shall be comprised of a cylindrical section, of identical diameter as the pipe, in which the high pressure tap is installed and shall incorporate a hydraulic shape employing at least two Vena Contractae to condition the flow profile before it enters the throat section.

The laying length of the throat shall be at least 0.5 times the throat diameter. The low pressure tap shall be installed in this section. The outlet cone shall be truncated, having an included angle of 10°.

The differential pressure shall indicate static pressure change only. Devices employing entire or partial pitot effects, amplifying differential by changing flow direction at the point of sensing pressure, thus introducing unwanted hydraulic noise, shall not be acceptable.

The tube coefficient shall be constant for pipe Reynolds number of about 50,000 and greater and independent of Beta ratio and line size.

The tube shall be constructed of cast iron, ASTM tentative specification for gray iron castings for valves, flanges and pipe fittings, designation A126, Class E suitable for installation in the pipe configuration shown. The pressure connection for the inlet section shall be bronze bushed. The throat liner shall be constructed of bronze or naval brass. The tube shall be furnished with a hand hole for inspection.
The entire tube, excepting the throat liner and pressure connection bushing, shall be coated with coal tar paint. The metering element shall not have debris-collecting cavities or annular chambers, but shall have a single pressure connection at the inlet and throat. In addition, a vent port and drain shall be included on a 90-degree plane to the metering tap on the inlet section.

The approval data shall state and substantiate the value and tolerance of the coefficient, the effect of upstream and downstream piping configurations, the head loss in percent of pipe velocity head and shall provide proof that the coefficient is independent of line size and beta ratio.

The accuracy shall be ±0.5% of actual rate of flow in the flow range indicated. This accuracy shall be substantiated by a two times standard deviation calculation of at least thirty calibrated tube coefficients of different line size and beta ratio sizes.

The Contractor shall certify, in writing, that the meter and the transmitter comply with the accuracy requirements of this section.

2.3 ELECTRONIC FLOW TRANSMITTER

Each flow transmitter shall be designed to translate pressure differential from the 36-inch venturi tube into a DC current output linear to flow through the venturi tube.

The transmitter shall utilize an inorganically bonded strain gage sensing element, electrically compensated for temperature errors. A differential pressure across the pressure sensing diaphragms shall cause a deflection in the strain gage sensing element providing a temperature compensated signal for amplification and conversion to a 4-20mA signal by integral solid-state electronics. The 4-20mA output signal shall be proportional to flow through the venturi tube.

Transmitter input range shall be 0 to 300 inches of water with an accuracy of 0.2% of calibrated span for a range of 6% to 100% of flow. The transmitter output signal shall be capable of driving a 500 ohm load. Static pressure effect shall be 0.5% of upper range limit. Temperature effect shall be 1.5% of upper range limit/100°F.

The transmitter shall be suitable for operation in ambient temperature range of 33°F to 80°F and a relative humidity of 0 to 100%. Transmitter enclosure shall be NEMA Type 4 suitable for installation on 2" diameter horizontal pipe. Process connections shall be 1/2" NPT with connection block. Electrical connections shall be 1/2" NPT conduit connection with integral screw terminals for output and test connections.

Diaphragm materials shall be 316 S.S. suitable for use with the media specified above. Body and connection block materials shall be 316 S.S. Transmitter shall operate on 24 VDC and shall be as manufactured by Bristol Babcock, Signature Model or Owner approved equal.

Two transmitters shall be manifolded together to achieve the 16:1 flow range. Switching between the low range and the high range transmitter
shall be automatic. One 4-20 milliamp signal, linear over the entire 16:1 range, shall be the output of the transmitter pair.

Automatic switching and re-scaling of low range and high range transmitter outputs shall be performed using a suppression discriminator module. Suppression discriminator module shall accept two 4-20mA signals of unequal scale and provide a single slope 4-20mA output. Module shall be suitable for panel mounting in the Main Control Panel as specified in Division 16. Suppression discriminator module shall be capable of driving a 500 OHM load and shall operate on 24VDC. Module shall be as manufactured by AGM Electronics, Inc., Model TA4014 or Owner approved equal.

2.4 VALVES AND TUBING

A. Tubing.....Tubing shall be soft annealed seamless copper tubing ASTM B-75 or as recommended by the manufacturer of the flow transmitter. Tubing shall be 1/2-inch O.D. (minimum).

B. Valves and Fittings.....Valves and fittings shall be full line size with swedge type fittings. Valves and fittings shall be furnished to connect the flow transmitter to the venturi tube as detailed on the Drawings. Valves and fittings shall be as manufactured by Swagelok or an Owner approved equal.

2.5 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 Chem-Prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General.....Installation shall be in accordance with manufacturer’s recommendations and as directed by the Owner. A manufacturer’s representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptably as determined by the Owner.

B. 36" Venturi.....The 36" venturi tubes shall be installed with pressure taps directed to the side. Pressure taps shall not be on the top or bottom of the venturi. Coordinate pressure tap location with transmitter installation as indicated on the Drawings.

C. Valves and Tubing.....Valves and tubing shall be installed as shown on the piping schematic on the drawings. All tubing shall slope 1/2 inch per foot (minimum) to air vent valves.
Tubing heat tracings and insulation shall be as specified in Division 16. Suppression discrimination modules shall be installed in the main control panels as indicated in Division 16.

D. Electronic Transmitter——Electronic transmitters shall be installed in strict accordance with the manufacturer’s instructions. The transmitters shall not be energized, nor shall any valve be opened which could pressurize the transmitters from the venturi tubes, until the installation has been inspected by the manufacturer’s on site representative. The manufacturer shall purge all pressure sensing lines of air, and calibrate the transmitters.

3.2 PERFORMANCE AND ACCEPTANCE TESTS

A. General——Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer or supplier, in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these Specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

B. Hydrostatic Test——The venturi shall be subject to the same pressure test as the process piping.

C. Performance and Acceptance Test——The 36'' venturis and electronic transmitters shall be calibrated over the entire flow range. An external pressure source shall be connected to the pressure ports on the transmitters which will produce pressures covering the entire range. A record of the 4-20 milliamp output signal versus induced differential pressure over the entire range shall be produced.

After calibration the transmitters shall be directly connected to the venturis. The differential pressure existing at this time shall be measured with a manometer and compared to the output 4-20 milliamp signal. Differential pressures ranging from 0-60 inches shall be measured with an air over water, inverted U-tube manometer. Differential pressures greater than 60 inches shall be measured with a mercury well type manometer. Manometers for testing shall be provided by the Contractor. Transmitter output signal and manometer readings shall be within 0.5% of full scale of each other.

End of Section
SECTION 10G - STEEL PIPE AND WYE BRANCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....This section includes the steel piping, wye branches, fittings, fitting reinforcement, interior coating, welding, handling, installation, and testing of the outlet works steel piping from the tunnel portal Station 10+06.85 to the point where it enters the control building. All above mentioned items shall be furnished by the Contractor and installed as shown in the drawings and as specified herein.

B. Related Work Described Elsewhere.....The tunnel steel liner upstream from the tunnel portal Station 10+06.85 shall be as specified in Section 10J, and the piping within the control building shall be as specified in Section 10H.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source....All items in this section shall be furnished and coordinated by the manufacturer of the wye branches.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.0D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings and catalog cuts.

1.4 PRODUCT HANDLING

A. Protection....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STEEL PIPE

A. General....The steel pipe, wye branches, fittings, bends, reinforcement, shop manufacturing processes, and field welding shall be
in accordance with AWWA, the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and the AWWA M-11 specifications.

B. Pipe Characteristics -

1. Steel pipe shall conform with ASTM A516, Grade 60 steel.

2. Minimum pipe wall thickness
   - 120", 96", and 72" inside diameters - 0.625 inch.
   - 48" and 30" inside diameters - 0.375 inch.

3. Internal working pressure 133 PSI with 0.35 PSI external pressure.

4. External pressure 10 PSI with 0.0 PSI internal pressure.

5. Flanges - AWWA Class E.

6. Field welded joints - single welded butt type.

2.2 FITTINGS AND ELBOWS

Fittings and elbows shall be in accordance with AWWA C208, AWWA M-11, and the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

2.3 WYE BRANCHES

Wye branches shall be in accordance with AWWA M-11, ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, be designed by the use of conical connections with side-wall angles equal to 7°, with the wye branch at a 45° angle with the main branch, and with all pipe centerline at the same elevation. The reinforcement elements of the wye branches shall be designed by the manufacturer in accordance with AWWA M-11 and the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and shall be submitted to the Owner for his approval.

2.4 MANUFACTURER

Special care shall be used in the manufacture of the steel pipe such that water passages and transitions are smooth and in proper alignment, and to assure smooth flow and to avoid cavitation damage. Special care shall be used in welding to avoid distortion and to insure water tightness. The steel pipe shall be manufactured in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, including 100% radiographic inspection of all butt welds (longitudinal, girth, or spiral), and AWWA specifications. Fillet welds shall be inspected by dye-penetrant or ultrasonic methods. The piping shall be shop assembled in one piece including reducers on lateral branches, with test heads, and hydrostatically tested to 200 psi. The conical sections shall then be studded as required to maintain roundness, match marked, and cut into lengths as required for shipment with ends beveled for field butt welding.

10G-2
2.5 WELDING

All welding shall be done by a process that protects the molten metal from the atmosphere and, where practicable, automatic machines shall be used. All welding shall be in accordance with the ASME Code. Butt welds shall have complete penetration.

Where weld metal is deposited in successive layers, each layer shall be cleaned thoroughly before the subsequent layer is deposited. Particular care shall be taken in aligning and separating the edges of plates to be joined by butt welding so that complete penetration and fusion at the bottom of the welds will be assured. After the welding is completed, all weld spatter shall be removed. The Contractor shall protect the work and the operator from the wind, rain, and snow during operations. No welding of any kind shall be done on wet surfaces or when the temperature of the steel for a distance of 12" on either side of the joint being welded is lower than 32°F. All field welded joints shall be 100% radiographically inspected.

2.6 QUALIFICATION OF WELDERS AND WELDING PROCEDURES

All welders and welding procedures shall be qualified in accordance with Section IX of the ASME Code. If any procedure has been previously qualified under the ASME Code, requalification will not be required. If in the opinion of the Owner the work of any welder at any time appears questionable, such welder shall be required to pass another qualification test. The test plates from which the specimens are to be prepared for qualification tests of welders shall be of such dimensions that all of the specimens required for test can be obtained with a discard at each end of test plate of not less than 2". The test plates shall be made of identical material used in the fabrication of the steel pipe.

The technique, including the rate, position, and welding electrodes used, shall be identical to that actually required for the fabrication. The preparation of all test plates shall be witnessed by the Owner. All qualification test of welders and test of welding procedures, including the physical tests of the specimens welded in the qualification tests, shall be made by the Contractor, who shall supply to the Owner certified copies of reports of physical tests of specimens welded in the qualification tests and tests of welding procedures.

2.7 SURFACE PREPARATION AND PRIME

A. No shop lining for steel pipe, fittings, bends, wye branches, and transitions shall be applied.

B. Surface preparation shall be Steel Structures Painting Council specification 6-63.

C. Exterior pipe surfaces embedded in concrete shall have no exterior coating.

D. Interior pipe surfaces shall be blasted to SSPC-SP-10 (near white metal)
and painted with one or more (as directed by the Owner) coats of high build coal tar epoxy to a 16 mil minimum dry film thickness (TENEMEC 46H413 Hi-Build Tneme-Tar, Amercoat 325, or Owner approved equal). Interior coating shall be applied according to AWWA C-200. The interior pipe coating shall be field applied.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. All steel pipe, fittings, bends, wye branches, and transitions shall be assembled at the factory for checking and aligning the fluidway surfaces. When the proper alignment has been achieved, the piping shall be marked sufficiently to assure that the same degree of alignment accuracy may be obtained during field assembly.

3.2 INSTALLATION

A. Steel Pipe, Fittings, Bends, Wye Branches....The steel pipe shall be assembled and erected in place accurately to line and grade in accordance with these specifications and as shown on the drawings. The Contractor shall supply such temporary supports and internal bracing as may be required to hold the sections in place and prevent distortion and transverse displacement of the sections during welding or embedment in concrete; however, the embedment of timber supports in concrete will not be permitted. During all pipe handling including fabrication, transportation, field installation and final alignment, the Contractor shall supply all supports necessary to ensure that the pipe maintains the diameter as shown on the Drawings. Maximum permissible deflection shall be +1/4" maximum deviation from the dimensions as shown on the Drawings. The welding of temporary attachments to the steel sections for the purpose of handling and fitting or aligning such sections to each other shall be limited to essential requirements, subject to the approval of the Owner. All such attachments shall be removed by chipping or flame cutting and any damage shall be welded and ground flush. Unless otherwise shown on the drawings, all field joints in the steel pipe shall be single-welded butt type and shall have complete penetration.

A manufacturer's representative, knowledgeable in this type of installation, shall be present during the installation of the pipe including the placing of the concrete surrounding the pipe. It shall be the representative's responsibility to direct the Contractor in installation and to assist the Owner in determining if the pipe has been aligned, leveled, and supported sufficiently to proceed with the placing of the mass concrete surrounding the pipe.

The concrete shall be placed evenly around the pipe and its surface shall be kept as closely as possible to the same elevation. It shall be placed continuously at a rate not to exceed 2 feet per hour, but shall be stopped if directed by the Owner.

After all fill concrete has been placed, grouting will be required to fill any voids left around the pipe. The steel pipe shall be "sounded"
to locate the void areas between the steel pipe and the concrete encasement. All void areas located shall be grouted by drilling through the steel pipe, grouting (according to these Specifications), and plugging the grout hole. The grout hole shall be drilled and tapped for a 5/8" diameter plug. Upon completion of grouting, the hole shall be plugged, welded, and ground smooth as shown on the Drawings.

B. Screw Jacks.....Screw jacks shall be used to support and align the steel pipe prior to placement of the surrounding concrete. There shall be sufficient number of the screw jacks so as to provide adequate support and safety as established by the pipe manufacturer and approved by the Owner. After final alignment adjustments, the screw jacks shall be securely fixed by lock nuts or jack welding.

C. Radiographic Inspection of Welds.....The entire length of all butt-welded longitudinal and girth joints of the pipe, including field-welded joints, shall be radiographed. Any butt-welded girth joint in the pipe not previously hydrostatically tested shall be radiographed. Unless otherwise specified, the radiographs shall conform to the ASME Code. Before radiographing the welds, the Contractor shall place suitable identification markers adjacent to the welds. The markers shall be painted, stamped, or fastened to the shells as directed by the Owner and shall not be removed until all of the welds in one joint have been accepted. In addition, corresponding markers shall be temporarily provided at each film location so that the images of these markers will appear on the radiographs. All radiograph films and reports shall be delivered to the Owner or his representative who shall judge the acceptability of all welded joints. Defects in welds shall be repaired in accordance with the ASME code. Portions of welds that have been repaired shall be reradiographed. The method of radiographing the welds, the equipment, and the technique used shall be subject to the approval of the Owner. Marking diagrams shall be submitted for approval in accordance with these specifications. All radiographs shall become the property of the Owner and shall be forwarded, properly identified, to Banner Associates, Inc., P. O. Box 550, 620 Plaza Court, Laramie, Wyoming, 82070.

3.3 FIELD TESTING

A. General.....Test shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

B. Hydrostatic Test.....The test shall consist of pressurizing the water filled section of line between the tunnel portal and the guard valves located in the control building. The hydrostatic testing shall be done prior to concrete encasement of the steel pipe. The Contractor shall
provide all equipment necessary to complete the test. The Contractor shall submit a test procedure, in writing, for the Owner's approval giving the details of the hydrostatic test; including equipment to be used, location of test heads, and type and location of supports.

The test shall consist of pressurizing the section of pipe in question to a pressure of 200 PSI and for a period of not less than 4 hours. The pressurized section of line, shall be visually inspected for leakage. Any item not conforming to these "no leakage" requirements shall be repaired or replaced and the test rerun. Any repairs, replacements, or additional tests performed shall be performed solely at the Contractor's expense.

End of Section
SECTION 10H - CONTROL BUILDING INTERIOR PIPING, FITTINGS, AND APPURTEINANCES

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes the control building's 24", 30", 36", 42", and 48" steel piping, concentric reducers, bends, blind flange, fittings, and all appurtenances to be installed within the control building. This section includes the 24-inch steel vent pipes for the control building. All above mentioned items shall be furnished by the Contractor, complete with all fittings, pipe supports, couplings, fasteners, etc. and shall be installed at the locations shown on the Drawings and as specified herein.

1.2 RELATED WORK DESCRIBED ELSEWHERE

The 48-inch cone valves as specified in Section 10A, the 42-inch fixed cone dispersion valves as specified in Section 10B, the 24-inch polyjet valves as specified in Section 10C, the 30-inch gate valve as specified in Section 10D, the 36-inch gate valves as specified in Section 10E, and the 36-inch venturi tubes as specified in Section 10F are to be installed in-line with the steel piping of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers and Equipment.....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.5 PRODUCT HANDLING

A. Protection.....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacements.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.
PART 2 - PRODUCTS

2.1 STEEL PIPE

A. General....Steel pipe shall be in accordance with AWWA Specification C200. Field welding of steel pipe shall be in accordance with AWWA Specification C206. Fittings shall be in accordance with AWWA Specification C208.

B. Pipe Characteristics -

1. Minimum yield strength - 36,000 PSI.

2. Pipe wall minimum thicknesses (24", 30", and 36" diameters) - 0.250 inch.
   (42" and 48" diameters) - 0.50 inch.

3. Flanges (all diameters) - AWWA Class E.

4. Field welded joints - single-welded butt type.

2.2 FITTINGS

Fittings shall be in accordance with AWWA C208. Minimum wall thickness, yield strength, flanges, and joints shall be the same as the pipe previously specified.

2.3 COUPLINGS

Couplings shall be dresser style 38 or approved equal. Joint harnesses shall be designed and installed in accordance with AWWA M11 steel pipe manual. Four joint harnesses will be installed at each coupling.

2.4 CONCRETE PIPE SUPPORTS

Concrete pipe supports shall be as shown on the Drawings.

2.5 PIPE HANGERS

Pipe hangers shall be as required and directed by the Owner for proper and complete installation of all piping. The pipe hanger manufacturer and model shall be submitted to the Owner for approval.

2.6 AIR-VACUUM VALVES

Air-vacuum valves shall be 4 inch APCO Model 152 or Owner approved equal. The air valves shall have piping from the discharge connection of the valve to the floor. The pipe shall be steel and shall be capable of withstanding the air and water pressures caused by the operation of the air valves, and shall operate with a drip-tight shut-off. The size of the piping shall conform to the valve manufacturer’s recommendations. Each air valve shall have an isolation shut-off valve. The valves shall be in accordance with these specifications. Outlets for air valves
shall be welded, flanged fittings conforming to the latest edition of AWWA C208.

2.7 PRESSURE GAUGES

The Contractor shall furnish and install pressure gauges as directed and approved by the Owner. Pressure gauges shall be accurate within 1% of full scale over a range of 0-150 PSIG. Pressure gauges shall be of a bourdon type with 6-inch dial and shall be as manufactured by Ashcroft Gauges or an Owner approved equal. Each pressure gauge shall be furnished with an isolation gate valve.

2.8 GATE VALVES

A. General.....The isolation gate valves shall be standard, iron bodied, bronze mounted, nonrising stem, gate valves with double disc gates having parallel seats. The valves shall be Mueller, Clow, or Owner approved equals. The valve ends shall be threaded or flanged compatible with air-vacuum valves and pressure gauges.

B. Operators.....The gate valves shall be handwheel manually operated. The valves shall be opened by turning the operating nut to the left (counterclockwise).

2.9 OUTLETS

Outlets for air-vacuum valves, pressure gauges, and other taps shall be reinforced tapped outlets, threaded or flanged in conformance with AWWA M11 - steel pipe manual.

2.10 QUALIFICATION OF WELDERS AND WELDING PROCEDURES

All welders and welding procedures shall be qualified in accordance with Section IX of the ASME Code. If any procedure has been previously qualified under the ASME Code, requalification will not be required. If in the opinion of the Owner the work of any welder at any time appears questionable, such welder shall be required to pass another qualification test. The test plates from which the specimens are to be prepared for qualification tests of welders shall be of such dimensions that all of the specimens required for test can be obtained with a discard at each end of test plate of not less than 2". The test plates shall be made of identical material used in the fabrication of the steel pipe.

The technique, including the rate, position, and welding electrodes used, shall be identical to that actually required for the fabrication. The preparation of all test plates shall be witnessed by the Owner. All qualification test of welders and test of welding procedures, including the physical tests of the specimens welded in the qualification tests, shall be made by the Contractor, who shall supply to the Owner certified copies of reports of physical tests of specimens welded in the qualification tests and tests of welding procedures.
2.11 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 chem-prime as manufactured by TNEHC Company at 300 square feet per gallon.

C. Field Coating.....Field coating shall be as specified in Division 9, Section 98.

D. Shop Lining For Steel Pipe and Fittings.....Lining shall be coal-tar epoxy in accordance with AWWA C210. Field repair of welded joints shall be in accordance with AWWA C210.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping.....All piping shall be erected accurately to line and grade in accordance with these specifications and as shown on the Drawings. The Contractor shall furnish any temporary supports and bracing as may be required to hold the pipe sections in place and prevent distortion during welding. During all pipe handling including fabrication, transportation, field installation and final alignment the Contractor shall supply all supports necessary to ensure that the pipe maintains the diameter as shown on the Drawings. Maximum permissible deflection shall be +1/4" maximum deviation from the dimensions as shown on the Drawings. The welding of temporary attachments to the steel pipe sections for the purposes of handling or fitting or aligning such sections to each other shall be limited to special requirements, subject to the approval of the Owner. All such attachments shall be carefully removed by careful chipping or flame cutting and any damage to the pipe shell shall be welded and ground flush. The Contractor shall repair any damage to the shop applied coatings sustained during the chipping, flame cutting, welding, or handling of the pipe. Unless otherwise shown on the Drawings or approved by the Owner, all field-welded joints shall be the single-welded butt type and shall have complete penetration.

Installations shall be in accordance with manufacturer’s recommendations and as shown on the Drawings.

B. Valves and Appurtenances.....Installation shall be in accordance with manufacturer’s recommendations and as shown on the Drawings.

C. Pipe Supports.....Pipe supports shall be installed where indicated on the Drawings. A 1/2-inch neoprene pad, full size of the pipe support, shall be placed between all concrete and mechanical pipe supports and the process piping.
3.2 STEEL WATER PIPE TESTING

A. Shop Tests....Shop tests shall be performed in accordance with AWWA Specification C200.

B. Field Test -

1. General....Test shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

2. Hydrostatic Test....Four (4) separate leakage tests shall be performed. Each test shall consist of pressurizing the water filled section of line between the upstream guard valve (48-inch cone valves or 36-inch gate valves) and the downstream control valve (42-inch fixed-cone dispersion valves or 24-inch poly jet valves). The hydrostatic test for that portion of the steel piping upstream of the guard valves shall be as specified in Section 10G.

Each test shall consist of pressurizing the section of line in question to a pressure of 200 PSI and for a period of not less than 4 hours. The pressurized section of line, including valves, shall be visually inspected for leakage. No leakage shall occur through (1) welded seams or joints on pipe, (2) metal on valves or pipe, (3) flanges on valves or pipe, (4) couplings, or (5) around stems on valves. Any item not conforming to these "no leakage" requirements shall be repaired or replaced and the test rerun. Any repairs, replacements, or additional tests performed shall be performed solely at the Contractor's expense. Valve test requirements are as specified in the appropriate specification sections.

Repair of defective shop welds shall be in accordance with Section 1.4.3 of AWWA Specification C200. Repair of defective field welds shall be in accordance with AWWA Specification C206.

3. Radiographic Inspection Of Field Welds....The entire lengths of all field welds shall be radiographed if deemed necessary by the Owner. Radiographs shall conform with the ASME Boiler And Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1. Before radiographing the welds, the Contractor shall place suitable identification markers adjacent to the welds. The markers shall be painted, stamped or fastened in the steels as directed by the Owner and shall not be removed until all of the welds in one joint have been accepted. In addition, corresponding markers shall be temporarily provided at each film location so that the images of these markers will appear on the radiographs. All radiographs shall be delivered to the Owner or his representative, who shall judge the acceptability of all welded joints.
Defects in welds shall be repaired in accordance with AWWA Specification C206 and all welds that have been repaired shall be reradiographed. The method of radiographing the welds and the equipment shall be subject to the approval of the Owner. Marking diagrams shall be submitted for approval in accordance with these specifications.

3.3 AIR-VACUUM VALVE TESTING

The valves' performance shall be inspected during the initial filling of the piping. If the valves do not function to the degree of efficiency anticipated by the Owner, the valves shall be replaced or repaired at no cost to the Owner, and the test shall be repeated. The Contractor shall be responsible for any damage incurred during the tests that the air valves should have prevented.

3.4 GATE VALVES, PRESSURE GAUGES, AND OTHER APPURTEANCES

Gate valves, pressure gauges, and other appurtenances shall be tested in conjunction with the Control Building piping. Equipment shall perform as specified.

3.5 STEEL VENT PIPE TESTING

A. Shop Tests.....Shop tests shall be performed in accordance with AWWA Specification C200.

B. Field Test.....Visual inspection of field welds shall be performed.

End of Section
SECTION 101 - STEEL TUNNEL LINER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included...This section includes the steel piping, fittings, fitting reinforcement, interior coating, welding, handling, installation, and testing of the outlet works steel piping from outlet works Station 0+00, elevation 6500, to the tunnel portal Station 10+06.85. All above mentioned items shall be furnished by the Contractor and installed as shown in the drawings and as specified herein.

B. Related Work Described Elsewhere...The steel pipe and wye branches from the tunnel portal Sta10+06.85 to the point where it enters the control building shall be as specified in Section 10G, and the piping within the control building shall be as specified in Section 10H.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment...All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source...All items in this section shall be furnished and coordinated by the manufacturer of the steel tunnel liner.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings and catalog cuts.

1.4 PRODUCT HANDLING

A. Protection...All means necessary will be used to protect materials, before, during, and after installation.

B. Replacement...In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STEEL PIPE

A. General...The steel liner pipe, fittings, bends, reinforcement, shop manufacturing processes, and field welding shall be in accordance with AWWA, the ASME Boiler and Pressure Vessel Code, Section VIII, Division
B. Pipe Characteristics -

1. Steel tunnel liner shall be AWWA C200 manufactured to meet the requirements of ASTM A139, Grade B.

2. Minimum pipe wall thickness
   120" inside diameter - 0.625 inch.

3. Internal working pressure 133 PSI with 0.35 PSI external pressure.

4. External pressure 75 PSI with 0.0 PSI internal pressure.

5. Flanges - AWWA Class E.

6. Field welded joints - single-welded butt type.

2.2 FITTINGS AND ELBOWS
------------------------
Fittings and elbows shall be in accordance with AWWA C208, AWWA M-11, and the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

2.3 STEEL PIPE
---------------
The steel pipe shall be in accordance with AWWA M-11, ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. The reinforcement elements of the steel pipe shall be designed by the Contractor in accordance with AWWA M-11 and the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

2.4 MANUFACTURER
------------------
Special care shall be used in the manufacture of the steel pipe such that water passages and transitions are smooth and in proper alignment, and to assure smooth flow and to avoid cavitation damage. Special care shall be used in welding to avoid distortion and to insure water tightness. The steel pipe shall be manufactured in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, including 100% radiographic inspection of all butt welds (longitudinal, girth, or spiral) and AWWA specifications. The tunnel liner steel pipe shall be hydrostatically tested at 60% of yield or 216 psi.

2.5 WELDING
----------
All welding shall be done by a process that protects the molten metal from the atmosphere and, where practicable, automatic machines shall be used. All welding shall be in accordance with the ASME Code. Butt welds shall have complete penetration.

Where weld metal is deposited in successive layers, each layer shall be cleaned thoroughly before the subsequent layer is deposited. Particular care shall be taken in aligning and separating the edges of plates to be joined by butt welding so that complete penetration and fusion at the
bottom of the welds will be assured. After the welding is completed, all weld spatter shall be removed. The Contractor shall protect the work and the operator from the wind, rain, and snow during operations. No welding of any kind shall be done on wet surfaces or when the temperature of the steel for a distance of 12" on either side of the joint being welded is lower than 32°F. All field welded joints shall be 100% radiographically inspected.

2.6 QUALIFICATION OF WELDERS AND WELDING PROCEDURES

All welders and welding procedures shall be qualified in accordance with Section IX of the ASME Code. If any procedure has been previously qualified under the ASME Code, requalification will not be required. If in the opinion of the Owner the work of any welder at any time appears questionable, such welder shall be required to pass another qualification test. The test plates from which the specimens are to be prepared for qualification tests of welders shall be of such dimensions that all of the specimens required for test can be obtained with a discard at each end of test plate of not less than 2". The test plates shall be made of identical material used in the fabrication of the steel liner.

The technique, including the rate, position, and welding electrodes used, shall be identical to that actually required for the fabrication. The preparation of all test plates shall be witnessed by the Owner. All qualification test of welders and test of welding procedures, including the physical tests of the specimens welded in the qualification tests, shall be made by the Contractor, who shall supply to the Owner certified copies of reports of physical tests of specimens welded in the qualification tests and tests of welding procedures.

2.7 GROUT HOLES

Grout holes shall be fabricated and installed as shown on the Drawings. Grout holes shall be threaded to facilitate plugging. Adjacent sections of pipe shall be match marked to ensure that upon field installation the grout holes are aligned in the positions shown on the Drawings.

2.8 SURFACE PREPARATION AND PRIME

A. No shop lining for steel pipe, fittings, and bends shall be applied.

B. Surface preparation shall be Steel Structures Painting Council specification 6-63.

C. Exterior pipe surfaces embedded in concrete shall have no exterior coating.

D. Interior pipe surfaces shall be blasted to SSPC-SP-10 (near white metal) and painted with one or more (as directed by the Owner) coats of high build coal tar epoxy tar epoxy to a 16 mil. minimum dry film thickness (TNEMLEC 46H413 Hi-Build Theme-Tar, Amercoat 325, or Owner approved equal). Interior coating shall be applied according to AWWA C-200. The interior pipe coating shall be field applied.

101-3
PART 3 - EXECUTION

3.1 FACTORY TESTING

A. All steel pipe, fittings, grout holes, sleeves, plugs, and bends shall be assembled at the factory for checking and aligning the fluidway surfaces. When the proper alignment has been achieved, the piping shall be marked sufficiently to assure that the same degree of alignment accuracy may be obtained during field assembly.

3.2 INSTALLATION

A. Steel Pipe, Fittings, Bends.....The steel pipe shall be assembled and erected in place accurately to line and grade in accordance with these specifications and as shown on the drawings. The Contractor shall supply such temporary supports and internal bracing as may be required to hold the sections in place and prevent distortion and transverse displacement of the sections during welding or embedment in concrete; however, the embedment of timber supports in concrete will not be permitted. During all pipe handling including fabrication, transportation, field installation and final alignment, the Contractor shall supply all supports necessary to ensure that the pipe maintains the diameter as shown on the Drawings. Maximum permissible deflection shall be \( \frac{1}{4}" + \) maximum deviation from the dimensions as shown on the Drawings. The welding of temporary attachments to the steel sections for the purpose of handling and fitting or aligning such sections to each other shall be limited to essential requirements, subject to the approval of the Owner. All such attachments shall be removed by chipping or flame cutting and any damage shall be welded and ground flush. Unless otherwise shown on the drawings, all field joints in the steel pipe shall be single-welded butt type and shall have complete penetration.

A manufacturer's representative, knowledgeable in this type of installation, shall be present during the installation of the pipe including the placing of the concrete surrounding the pipe. It shall be the representative's responsibility to direct the Contractor in installation and to assist the Owner in determining if the pipe has been aligned, leveled, and supported sufficiently to proceed with the placing of the mass concrete surrounding the pipe.

The concrete shall be placed evenly around the pipe and its surface shall be kept as closely as possible to the same elevation. It shall be placed continuously at a rate not to exceed 2 vertical feet per hour, but shall be stopped if directed by the Owner.

After all fill concrete has been placed, grouting will be required to fill any voids left around the pipe. The steel liner shall be "sounded" to locate the void areas between the steel liner and the concrete encasement. All void areas located shall be grouted by drilling through the steel liner, grouting (according to these Specifications), and plugging the grout hole. The grout hole shall be drilled and tapped for a \( \frac{5}{8}" \) diameter plug. Upon completion of grouting, the hole shall be plugged, welded, and ground smooth as shown on the Drawings.
B. Screw Jacks.....Screw jacks shall be used to support and align the steel pipe prior to placement of the surrounding concrete. There shall be sufficient number of the screw jacks so as to provide adequate support and safety as established by the pipe manufacturer and approved by the Owner. After final alignment adjustments, the screw jacks shall be securely fixed by lock nuts or jack welding.

C. Radiographic Inspection of Welds.....The entire length of all butt-welded longitudinal and girth joints of the pipe, including field-welded joints, shall be radiographed. Any butt-welded girth joint in the pipe not previously hydrostatically tested shall be radiographed. Unless otherwise specified, the radiographs shall conform to the ASME Code. Before radiographing the welds, the Contractor shall place suitable identification markers adjacent to the welds. The markers shall be painted, stamped, or fastened to the shells as directed by the Owner and shall not be removed until all of the welds in one joint have been accepted. In addition, corresponding markers shall be temporarily provided at each film location so that the images of these markers will appear on the radiographs. All radiograph films and reports shall be delivered to the Owner or his representative who shall judge the acceptability of all welded joints. Defects in welds shall be repaired in accordance with the ASME code. Portions of welds that have been repaired shall be reradiographed. The method of radiographing the welds shall be subject to the approval of the Owner. Marking diagrams shall be submitted for approval in accordance with these specifications. All radiographs shall become the property of the Owner and shall be forwarded, properly identified, to Banner Associates, Inc., P. O. Box 550, 620 Plaza Court, Laramie, Wyoming, 82070.

3.3 FIELD TESTING

A. General.....Test shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

B. Hydrostatic Test.....The test shall consist of pressurizing the water filled section of the tunnel steel liner between outlet works station 0+00 and the tunnel portal station 10+06.85.

The test shall consist of pressurizing the section of pipe in question to a pressure of 200 PSI and for a period of not less than 4 hours. The Contractor shall provide all equipment necessary to complete the test. The Contractor shall submit a test procedure, in writing, for the Owner's approval giving the details of the hydrostatic test; including equipment to be used, location of test heads, and type and location of supports. The pressurized section of line, shall be inspected for leakage. Any item not conforming to these "no leakage" requirements...
shall be repaired or replaced and the test rerun. Any repairs, replacements, or additional tests performed shall be performed solely at the Contractor's expense.

End of Section
SECTION 10J - 24-INCH GATE VALVES WITH MANUAL OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included....This section includes the 24" gate valves, complete with manual operators. All above mentioned items shall be furnished by the Contractor and installed in the diversion tunnel as shown on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, NEMA, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source....All items in this section shall be furnished and coordinated by the manufacturer of the gate valves.

1.3 SHOP DRAWINGS

Shop Drawings shall be submitted in accordance with the General Requirements, Section 1.0 of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

A. Protection....All means necessary will be used to protect materials, before, during and after installation.

B. Replacement.....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 24-INCH GATE VALVE

A. General....The 24" gate valves shall be in accordance with AWWA specification C500 and shall be Dresser M& H Style 67, AWWA gate valves, or Owner approved equal.

B. Valve Operating Characteristics.....The valve shall have the following characteristics.

1. Size - 24-inch.

2. 25 PSI normal working pressure.
3. 50 PSI maximum differential pressure.


5. Non-rising stem.


7. Suitable for operation with manual operator.

8. Body - cast iron, bronze mounted.


10. Seals - O-ring.

11. Maximum velocity - 20 FPS.

2.2 MANUAL OPERATOR

A. General....The 24-inch gate valves shall be handwheel manually operated. The operator shall be integrally mounted with the valve and shall be designed to hold the gate valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. The valves shall be opened by turning the operating nut to the left (counter clockwise). The operators shall conform to AWWA C500, latest revision.

B. Operating Conditions -

1. Capable of operating the valve under the above valve operating conditions.

2. Ambient temperature: 0°F to 80°F.

2.3 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be steel structures Painting Council Specification 6-63.

B. Shop Prime.....Shop primer shall be 1 coat 77 Chem-Prime as manufactured by TNEMEC Company at 300 square feet per gallon (2.0 mils dry).

C. Field Coating.....Field coating shall be as specified in Division 9, Section 9B.

3.1 INSTALLATION

Installation shall be in accordance with manufacturer’s recommendations and as directed by the Owner. A manufacturer’s representative knowledgeable in this type of equipment shall be present at start-up until all items are working acceptable as determined by the Owner.
3.2 TESTING

A. Shop Tests....Shop tests on the valve shall be performed in accordance with Section 5 of AWWA Specification C500 with test records and results being forwarded, properly identified, to Banner Associates, Inc., P.O. Box 550, Laramie, Wyoming, 82070. Test reports shall include dates, personnel making tests, equipment or materials tested, serial numbers, tests performed, and results. Shop testing shall be performed at no additional cost to the Owner.

B. Performance and Acceptance Tests -

1. General.....Tests shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

   All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

2. Overall Performance Tests.....Testing of the gate valve's overall performance shall consist of operating the valve throughout its entire range of travel.

   Movement of the valve shall occur in a smooth, uninterrupted fashion.

End of Section
SECTION 10K - DIVERSION TUNNEL - 24-INCH STEEL PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes all pipe, fittings, supports, and all appurtenances to be installed in the diversion tunnel. The above mentioned shall be furnished and installed by the Contractor as shown on the drawings and as specified herein.

1.2 RELATED WORK DESCRIBED ELSEWHERE

These diversion tunnel-gate valves as specified in Section 10J are to be installed in line with the steel piping of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers and Equipment....All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, AWWA, ANSI, ASTM, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source....All items in this section shall be furnished and coordinated by one fabricator or manufacturer.

1.4 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.0D of these specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.5 PRODUCT HANDLING

A. Protection....All means necessary will be used to protect materials, before, during, and after installation.

B. Replacements....In the event of damage, all necessary repairs or replacements will be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 STEEL PIPE

A. General....Steel pipe shall be in accordance with AWWA Specification C200. Field welding of steel pipe shall be in accordance with AWWA Specification C206. Fittings shall be in accordance with AWWA Specification C208.
B. Pipe Characteristics -

1. Minimum yield strength - 36,000 PSI.

2. Pipe wall thickness (24" diameter) - 0.250 inch.

3. Flange (24" diameter) - AWWA Class D.


5. Pipe shall be furnished in 20-foot net laying lengths.

2.2 FITTINGS

Fittings shall be in accordance with AWWA C208. Minimum wall thickness, yield strength, flanges, and joints shall be the same as the pipe previously specified.

2.3 COUPLINGS

Couplings shall be Dresser Style 38 or Owner approved equal.

2.4 JOINTS

0-ring joints shall be used. The bell and spigot 0-ring type joints shall consist of a bell and spigot end formed integrally on the pipe by washing, rolling or expanding the gasket shall be retained on the spigot end by a groove formed by rolling with dies. At no point in the spigot end shall the clear inside diameter of the pipe be less than the nominal inside diameter of the pipe barrel. The inside of the bell end and the outside of the spigot ends shall be smoothed by grinding as necessary and shall be free of raised bumps and scratches. Both bell and spigot ends shall be sized by expanding to provide a tolerance of not less than 0.03-inch and not more than 0.09-inch difference in circumferential measurement between the outside circumference of the spigot and the inside circumference of the bell at the sealing point of normal engagement and shall be designed so that the gasket shall be the sole element of the joint depended upon to keep the joint watertight over all normal conditions of service, including expansion and contraction. The gasket for the joint shall be a continuous 0-ring gasket made of a special rubber composition of such size and cross section as to provide a watertight joint for a pressure equal to the test pressure of 150 psi. The gasket shall conform to gasket material requirements set forth in AWWA C-200. The joint shall provide for a maximum reflection with a 3/4-inch pull out. Welded joints may be used if recommended by the manufacturer. Field welded joints shall be single-welded butt type with complete penetration in accordance with AWWA C206.

2.5 PIPE SUPPORTS

Pipe supports shall be furnished as required by the Contractor for installation. Installation shall be suitable for temporary support of the 24-inch pipe with an approximate vertical distance of 1'-6" from pipe centerline to tunnel invert, until the fill concrete is placed
surrounding the pipe. A minimum of two supports shall be required for each 20-foot net length of pipe. Supports shall be adjustable pipe saddle supports similar and equal to those manufactured by Grinnell, Figure 264.

2.6 SURFACE PREPARATION AND PRIME

A. Surface Preparation.....Surface preparation shall be Steel Structures Painting Council Specification 6-63.

B. Shop Lining for Steel Pipe and Fittings.....Lining shall be coal-tar epoxy in accordance with AWWA C210. Field repair of welded joints shall be in accordance with AWWA C210.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping.....All piping shall be erected accurately to line and grade in accordance with these specifications and as shown on the drawings. The Contractor shall furnish any temporary supports and bracing as may be required to hold the pipe sections in place and prevent distortion during welding. The welding of temporary attachments to the steel pipe sections for the purposes of handling or fitting or aligning such sections to each other shall be limited to special requirements, subject to the approval of the Owner. All such attachments shall be carefully removed by careful chipping or flame cutting and any damage to the pipe shell shall be welded and ground flush. Unless otherwise shown on the drawings or approved by the Owner, all field-welded joints shall be the single-welded butt type and shall have complete penetration.

Installation shall be in accordance with manufacturer’s recommendations and as shown on the drawings.

3.2 STEEL WATER PIPE TESTING

A. Shop Tests.....Shop tests shall be performed in accordance with AWWA Specification C200.

B. Field Test -

1. General.....Test shall be conducted in the presence of the Owner. The Contractor shall also perform any tests which might be recommended by the manufacturer, supplier, or Owner in addition to those specified in this section, to determine that equipment, materials, or systems meet all requirements of these specifications.

All testing shall be performed solely at the Contractor’s expense along with the replacement or repair of any equipment or materials damaged due to use of unapproved test procedures or due to improper handling of test apparatus.

Repair of defective shop welds shall be in accordance with Section 1.4.3 of AWWA Specification C200. Repair of defective field welds shall be in
accordance with Section 7.1 of the AWWA Specification C206.

3.3 GATE VALVES AND OTHER APPURTENANCES

Gate valves, pressure gauges, and other appurtenances shall be tested in conjunction with the diversion tunnel piping. Equipment shall perform as specified.

End of Section
SECTION 10L - STREAM GAGING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

This work includes furnishing all labor, materials, and equipment and performing all operations required for furnishing, transporation, and installation of water level recorders, staff gages, and water level transmitters. Water level recorders shall be furnished and installed in all seven gaging stations. Staff gages shall be furnished for all gaging stations except Deer Creek in Glenrock and Deer Creek in Canyon. Water level transmitters shall be furnished and installed in each of the four CMU gage houses.

1.2 RELATED WORK

A. Gage House Shelters, Stilling Wells, and Appurtenances: Section 2BB.
B. Instrumentation and Control Systems: Section 16F.

1.3 QUALITY ASSURANCE

All materials shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. The material shall be free of defects, flaws, or damage incurred during manufacture, transporation, storage or placement.

1.4 SHOP DRAWINGS

Required shop drawings as specified in the General Requirements, Section 1D, shall be submitted to the Owner for approval.

1.5 PRODUCT HANDLING

A. Protection....All means necessary shall be taken to protect these materials, before, during, and after installation.
B. Replacement....In the event of damage, all necessary repairs or replacements shall be made, subject to the approval of the Owner, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 WATER LEVEL RECORDER

Water level recorders shall be Leupold & Stevens, Inc., Type A Model 71 recorder; no substitutions will be allowed. Each Type A Model 71 recorder shall comply with the following specifications:
Chart Drive 6 month negator spring driven clock
Time Scale Designation 2.4 inches/day
Gage Scale 1:6
Chart A-10
Float Pulley 18-inch circumference for perforated tape
Float Tape Stainless steel perforated and graduated float tape with set end hooks and index bracket. Graduated in feet, tenths, and hundredths
Float with Counterweight 12-inch float
Accessories Reversal indicator
Options Capillary pen with lucite reservoir and 1 oz. black ink

The stainless steel perforated and graduated float tape lengths for the seven gaging stations shall be as follows:

<table>
<thead>
<tr>
<th>Gaging Station</th>
<th>Float Tape Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Creek in Glenrock</td>
<td>15'</td>
</tr>
<tr>
<td>Deer Creek in Canyon</td>
<td>20'</td>
</tr>
<tr>
<td>Deer Creek above Deer Creek Reservoir</td>
<td>15'</td>
</tr>
<tr>
<td>West Fork Deer Creek</td>
<td>15'</td>
</tr>
<tr>
<td>King Creek</td>
<td>15'</td>
</tr>
<tr>
<td>Davis Creek</td>
<td>10'</td>
</tr>
<tr>
<td>Duck Creek</td>
<td>15'</td>
</tr>
</tbody>
</table>

2.2 STAFF GAGES

The Contractor shall furnish seven 6.67' (comes in two sections) staff gages. Staff gages shall be Leupold & Stevens, Inc. porcelain enameled iron gages, Style A. Installation will be by others.

2.3 WATER LEVEL TRANSMITTER

Water level transmitters shall be in accordance with Section 16F.

PART 3 - EXECUTION

3.1 WATER LEVEL RECORDER

The water level recorders shall be installed and securely mounted on a level shelf over the stilling well, in accordance with the manufacturer's instructions and located as shown on the Drawings. Care shall be taken so that float lines, float, and counterweight hang freely and are not in contact with stilling well openings or stilling well piping.
3.2 WATER LEVEL TRANSMITTER

Water level transmitter shall be installed at the locations shown on the Drawings in strict accordance with the manufacturer's recommendations. Transmitter shall be mounted true and level, securely anchored to walls or equipment stands as indicated on the Drawings. Process variable signal connections and power connections shall be as indicated on the Drawings and in accordance with Section 16F.

End of Section
PART 14A - CRANE AND CRANE BRIDGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included.....Furnish and install crane and crane bridge as described herein and indicated on the drawings, including:

1. 12 ton capacity crane.
2. 12 ton capacity crane bridge.

B. Related Work Described Elsewhere.....Structural Steel: Section 5A.

1.2 QUALITY ASSURANCE

A. Standard Products.....Materials and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of this type of equipment product and shall essentially duplicate equipment that has been in satisfactory use for a period of at least 3 years prior to bid opening. Equipment standard with the manufacturer and generally meeting the requirements of this specification as to performance and quality of materials and workmanship but differing from the requirements of this specification in minor details only, will be acceptable subject to approval of Owner.

B. Workmanship.....Materials and equipment shall be installed in accordance with the recommendations of the manufacturer and in conformance with the contract drawings. Erection procedures such as welding, bolting and connections shall be made in accordance with SECTION 5A: STRUCTURAL STEEL.

C. Manufacturer’s Supervision.....The manufacturer of the crane shall provide a service engineer experienced in this type of installation who shall act as a consultant during the erection of the crane and the installation of electric cables and controls pertaining thereto. He shall test-operate the crane upon completion, in the presence of, and as directed by, the Owner.

1.3 SHOP DRAWINGS

A. In accordance with General Requirements Section 1.D, the Contractor shall submit for approval, data as specified herein on the following:

1. Plan layout and details of track and supports, power conductors and pick-ups, control stations, and supports.

2. Catalog cuts and other descriptive literature, prepared to show specifically the material and equipment to be incorporated in the crane system. Nonapplicable details and data shall be blanked.
1.4 PRODUCT DELIVERY, STORAGE, HANDLING

A. All equipment and materials described herein shall be delivered to the job site, safely stored, moved to final locations, and protected prior to, during, and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. If the Contractor desires to furnish other than specified materials, he shall, before submitting, make certain the materials are equal to those in the specifications; in addition, the Contractor shall verify that critical clearances between the crane and building components are maintained. The Contractor may then submit a list of the materials he wishes to substitute. The list shall be complete with descriptive data indicating all the physical properties and other data required to make a fair comparison between those items specified and those to be substituted.

2.2 DESIGN STANDARDS

A. All support structures and structural steel, except trackage, shall be designed in accordance with the applicable specifications of the American Institute of Steel Construction as set forth in SECTION 5A: STRUCTURAL STEEL. Other materials such as rope casting, forgings, and stampings shall be designed with an allowable stress not to exceed 20 percent of the ultimate strength of the material.

2.3 NAMEPLATES

A. Each major item of equipment shall have the manufacturer's name or trademark, with address and catalog number on a plate securely attached thereto.

2.4 MATERIALS

A. Bearings. All bearings shall be antifriction type and shall be arranged for lubrication either by splash system or by high pressure grease fittings (and shall be dripproof).


C. Forgings. Shall conform to ASTM A 668.

D. Structural Steel. Shall conform to Fed. Spec. QQ-S-741 or ASTM A 36, except that crane bridge rails for top running trolleys shall be specially rolled or fabricated sections with load carrying flange of carbon steel of chemical composition conforming to ASTM A 2, Class A.

E. Hoist Rope. Hoist rope shall be of the best quality, flexible, plow steel, wire rope with a hemp center, conforming to applicable provisions of Fed. Spec. RR-W-410. Rope shall be suited for the service requirements to be accomplished and shall afford a design load safety
factor of no less than five.

F. Motors –

1. Fractional Horsepower Motors, AC....Fed. Spec. CC-M-1807 and NEMA MG 1.

2. Integral Horsepower Motors, AC....Fed. Spec. CC-M-1807 and NEMA MG 1.

G. Motor Controls.....NEMA ICS and Underwriter's Laboratories, Inc., UL 508.

H. Wheels....The wheels of crane truck and trolley shall be of drop forged steel, heat treated, or cast iron with chilled treads and shall have a minimum hardness of 425 Brinell.

2.5 BRIDGE CRANE

A. The crane shall be of the top running type designed for a minimum hook load capacity of 24,000 lbs., with a minimum safety factor of 5. The cranebeam drive shall be electric motor driven. The bridge crane system shall conform to the applicable portions of the Crane Manufacturers' Association of America Specifications for Electric Overhead Traveling Cranes for Class A service.

B. Hangers....Hangers and bracing required shall be secured to the supports at the points shown on the contract drawings using clamps, bolts and/or welding. All bolts or clamps shall be secured with lock washers or other type fasteners which will prevent loosening of connections. If bolt holes are required templates or other necessary information shall be furnished by the crane manufacturer to permit the fabricator of the structural steel support framing to shop-punch the necessary holes.

C. Rails.....Crane runway rails, splices and fastenings are specified in Structural Steel: Section 5A. Crane bridge rails, and other sections shall be straight and true. Rail joints shall be flush and true without misalignment of web of running tread and shall be designed to minimize vibration. The gap between adjacent rail ends and the vertical misalignment of running treads shall not exceed 0.0625 inch.

D. Cranebeam Drive.....Cranebeam drive shall be by geared motor. Cranebeam shall be driven at both bridge tracks and shall allow operation at a speed range of 0 to 100 feet per minute with a controlled movement of 1/4-inch. The drive shall be totally enclosed and shall run in an oil bath. The gearing and shafting shall be of carbon steel forgings.

E. Brakes.....Bridge travel shall be controlled by electrically-released disc-type brake.

2.6 TROLLEY

A. All trolley wheels shall have machined treads and shall be equipped with roller or ball bearings of capacity as recommended by the bearing manufacturer for the design load of the trolley. All trolley yokes and
load bars shall be of drop forged, cast, or rolled steel. The trolley shall be driven by an integral electric motor or, at the option of the Contractor, by a separate electric motor driven trolley tractor. The motor shall be geared to the trolley so as to allow a trolley operating speed range of 0 to 80 feet per minute with a minimum controlled movement of 1/4-inch. The drive mechanism shall be totally enclosed and shall run in an oil bath. Drive mechanism shall be provided with a limit switch and electric brake.

2.7 HOIST

A. Hoist for crane shall be motor operated. The hoist shall be designed to provide a minimum hook lift of 20 feet above the lower level floor.

B. Motor-Operated Hoist shall be designed for a minimum hook load capacity of 24,000 pounds with a safety factor of 5 and shall allow a hoist hook speed range of 0 to 20 feet per minute with a minimum controlled movement of 1/4-inch.

1. Brakes. Hoist shall have a mechanical load brake and a solenoid clapper motor brake which shall be equally effective in both directions of travel.

2. Hoist Drum. The hoisting drum shall be of alloy cast iron or of welded steel. The diameter of the drum shall be not less than twenty-four (24) times the diameter of the hoist cable. The drum shall be grooved to take the full run of cable for the required lift without overlapping, plus a minimum of one and one-half (1-1/2) full wraps of cable when load is on the lower level floor. The drum grooves shall be cut from solid stock and have sufficient depth for size of cable required. The drum flanges shall be guarded so that the cable cannot wedge between drum flange and hoist frame.

3. Limit Switches. Motor-operated hoist shall be protected by upper and lower limit switches.

2.8 ELECTRICAL WORK

A. All electrical equipment and wiring and the installation thereof shall be in accordance with applicable sections of Division 16.

B. Electrification. Power for bridge motor, trolley motor and hoist motor shall be supplied from enclosed (copper) conductors mounted on a runway track and on a trolley track by means of phenolic insulator blocks or conducting bar brackets. Collectors shall be of the wheel or shoe type and shall provide positive contact and permit high-speed operation without causing damage to the system. A grounded transformer circuit to eliminate one conductor shall not be used. Conductors shall be sized for 125% full-load current of largest motor and full-load currents of all additional motors, but in no case less than #12 AWG. Runway conductors shall be furnished complete with all mounting brackets, power feed connectors, end caps, etc. Power for bridge crane operation will be 480 volt, three-phase, 60-hertz. A 60 amp three-pole circuit breaker, 30 amp non-fused disconnect switch, and three #4 AWG,
75°C, conductors power feeder circuit is called for on the drawings. Should a larger power feeder circuit be required, all equipment associated therewith shall be provided at no additional cost to the Owner.

C. Motors –

1. Rating.....All motors shall be of sufficient size for duty to be performed and shall not exceed the full load rating when the driven equipment is operated at specified capacity under the most severe condition likely to be encountered. In addition, all motors installed above mean sea level altitude of 3,300 feet shall be derated 1% for each 330 feet or fraction thereof above 3,300 feet. Derating due to altitude will not be required on hermetically sealed and integrally mounted motors. Integraly mounted motors are those in equipment where the motor housing and driven equipment housing are integral and on the same common shaft. The horsepower rating indicating on the electrical plans are for guidance only; do not limit the equipment size.

2. Insulation.....All motors, unless otherwise specified herein, shall conform to Fed. Spec. CC-M-1807 and NEMA Pub. No. MG-1. Motors shall be rated at the voltage as specified on the drawings. Winding insulation shall be either Class B, F or H and and temperature rise of the motor furnished shall not exceed that permitted by the applicable NEMA Standard for the class of insulation used. Locked-rotor code letter shall be Code G or better. Unless otherwise specified, duty classification shall be based on 40 degrees C. ambient temperature of reference. The time ratings shall be as follows:

<table>
<thead>
<tr>
<th>Temperature Rise</th>
<th>Time Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 degrees C</td>
<td>30 min</td>
</tr>
</tbody>
</table>

3. Housing.....Unless otherwise specified, the housing shall be drip proof construction.

D. Controls.....Motors shall be provided with controllers to suit the application. Reversing starters shall be fully magnetic with both mechanical and electrical interlocks. Controllers shall be in NEMA Type 2 enclosures. All motion shall be controlled from the floor by a pendant control station and shall be attached to the unit in such a manner that the conductor cord does not carry any weight of the station. Control voltage shall not exceed 120 volts. The electrical equipment and controls shall be such that inching service will be available for any motor concerned.

Minimum control movements shall not exceed the following:

- Hoist 1/4 inch
- Trolley 1/4 inch
- Bridge 1/4 inch

The controls for the Bridge and Trolley shall be AC wound rotor five (5) step variable speed consisting of 4-steps of acceleration, with the fifth step operating at synchronous speed. Plugging control shall utilize the motor reversing torque as a brake.
The hoist control shall be AC wound rotor five (5) step variable speed with the lowering speed controlled by an eddy current brake in conjunction with a mechanical load brake.

Normal operation of the crane shall be from a traveling pendant control station which shall travel the full span of the crane. The control station shall allow for completely independent operation of the crane. The control panel shall control a mainline contactor which will shut off all power to crane. The traveling pendant control station shall include provisions for raising the complete unit to 7'-0" (clear) above the floor.

2.9 PAINTING

A. All metal surfaces exposed after erection, except contact surfaces between moving parts, and resilient and flexible parts shall be painted.

B. Prime Coats -

1. Structural Steel and Electrical Items.....shall be primed in the shop in accordance with the applicable sections of this specification.

2. Mechanical Items.....shall be primed in the shop in accordance with Section: Painting, General, or the manufacturer's standard as approved.

C. Finish Coats.....shall be in accordance with Section 9B, except that shop finish painting may be in accordance with the manufacturer's standard as approved, or (for electrical items) with standards referenced in the applicable sections of this specification.

2.10 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of crane, such as for a complete and proper installation of crane, such as runway stops, shall be selected by the Contractor from the manufacturer’s standard components and recommended installation requirements, subject to the approval of the Owner.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection -

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the crane and crane bridge may be installed in complete accordance with all pertinent codes and regulations, the original design, the accepted shop drawings, and manufacturer’s recommended installation instructions.
B. Discrepancies -

1. In the event of a discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Install the crane and crane bridge in strict accordance with all pertinent codes and regulations, the original design, and the accepted shop drawings.

3.3 TESTING

A. General.....The Owner shall be notified at least 48 hours prior to beginning the tests and shall be present during all tests unless the requirement is waived in writing. The Contractor shall furnish all test loads and equipment. All tests shall be fully documented in a report by the Contractor.

1. Factory Tests.....Factory tests are required for all bridge crane hoists.

2. Operational Tests.....Prior to shipment from the factory, the hoisting and lowering functions of all hoists shall be tested at all speeds at no load, 50 percent and 100 percent of rated load capacity. Pendant controls shall be demonstrated to show they operate as specified.

B. Field Tests.....Field tests are required for crane systems. A representative of the subcontractor responsible for procuring the crane systems equipment shall be present and shall direct all field tests.

1. Operational Tests.....Following installation but prior to approval, all crane systems shall be tested before use to ensure compliance with this specification, including the following functions: hoisting and lowering, operation of brakes, travel limit switches, and safety devices. Trip-setting of limit switches and safety devices shall be determined by tests under no-load conditions. Tests shall be conducted first by hand, if practical, and then under the lowest speed obtainable. Test with increasing speeds up to maximum crane speed. Each complete crane system shall be tested at rated load and rated speeds. All crane systems shall be tested to determine that the hoists, including hooks and pendants, are grounded during all phases of hoist operation.

2. Overload Tests.....After the operational tests, all functions of all crane systems shall be tested at 125 percent of rated load. Each crane system shall be operated through its complete range of operation until three consecutive successful operations are achieved to demonstrate compliance with contract requirements.
C. Adjustment and Repairs.....Any unsafe condition disclosed by the inspections and tests shall be corrected. Adjustments and repairs shall be done by the Contractor. After adjustments are made to ensure correct functioning of components, pertinent tests shall be repeated until the crane systems are approved by and at no additional cost to the Owner.

3.4 MAINTENANCE AND OPERATING INSTRUCTIONS

A. In accordance with the General Requirements, Section 1.D the Contractor shall furnish six (6) sets of instruction booklets for operation and maintenance of the equipment specified in this section. Included therewith shall be spare-parts data, for each item of equipment in the system, consisting of a complete list of parts and supplies with current unit prices and sources of supply.

End of Section
SECTION 14B - GONDOLA SYSTEM
PART 1 - GENERAL

1.1 DESCRIPTION

The work in this section consists of providing all labor, material, and equipment required for the Contractor to design and construct an aerial gondola system. The system shall include all cables, cable hardware, sheaves, rollers, gondolas, support structures, structure foundations, controls, control wiring, prime mover, all speed reducers and gearing, all brakes, overspeed devices, counterweight system, all manual and automatic stop devices, all electrical work, lightning protection, emergency evacuation equipment, all testing, equipment buildings, and all incidentals required to complete the work in accordance with the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications of AASHTO, ANSI, ASTM, etc. The work in this section shall be performed by journeymen well-versed in the trades.

1.3 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with the General Requirements, Section 1.0 of these Specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings or catalog cuts.

1.4 PRODUCT HANDLING

Contractor shall use all means necessary to protect materials before, during, and after installation. In the event of damage, the Contractor shall make all necessary repairs or replacements to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GONDOLA SYSTEM

A. General.....The Gondola System shall be a single-reversible type system designed, manufactured, and constructed in accordance with the latest standard edition of ANSI B77.1 - "American National Standard for Passenger Tramways-Aerial Tramways and Lifts, Surface Lifts, and Tows - Safety Requirements". The Gondola System shall be layed out along the alignment shown on the Drawings or as approved by Owner.

B. Site Specific Design Requirements -

1. The system shall be designed for a wind speed of 90 mph with exposure C as defined by UBC 2311.
2. The system shall be designed for an earthquake Zone 1 as defined by UBC 2312.

3. The system shall have one enclosed car of 30 square feet.

4. The car shall be capable of transporting 1,000 lbs.

5. The car shall have one door that can be unlocked from both the inside and outside of the car.

6. The door lock shall be interlocked with the control system such that the gondola system will not operate if the door is unlocked.

7. The system shall be controlled from within the car.

8. The maximum speed of the system shall be 500 feet per minute.

9. The landings shall be designed for a dead load of 125 psf, point load of 1,000 lbs., and a snow load of 100 psf.

10. The equipment buildings shall be designed with bullet-proof doors, walls, and roof.

11. The system shall be designed for proper vertical clearance over the emergency access trail.

12. The system shall not require provisions for nighttime operation nor for emergency lighting.

13. The system shall not have an auxiliary power unit.

14. The system shall not have a two-way voice communication system.

15. The system shall not require an operator's hut.

16. The emergency evacuation equipment shall be located within the car.

2.2 FOUNDATIONS

A. General....All foundations shall conform to the following Sections of the Specifications.

1. Concrete Formwork - Section 3A.

2. Concrete Reinforcement - Section 3B.

3. Cast-in-Place Concrete - Section 3C.

4. Concrete Appurtenances - Section 3D.

5. Rock Reinforcement - Section 2I.

B. Design Parameters -
1. Frost depth has been assumed to be 4 feet.

2. Soil bearing pressures have been assumed to be 2,000 psf for colluvium, 10,000 psf for the upper 10 feet of rock, and 15,000 psf for rock below 10 feet.

3. Concrete for all footings shall be Class B.

**PART 3 - EXECUTION**

3.1 All excavations for foundations and electrical conduits shall conform to Section 2C of the Specifications.

3.2 Waste material shall be disposed of in accordance with Section 2G of the Specifications.

3.3 Backfill material shall conform to Section 2F of the Specifications.

3.4 All foundations shall be installed as specified herein.

3.5 The gondola system shall be installed as specified herein.

3.6 The electrical work required for the gondola system shall include wiring, conduit, motor starter, disconnect, controls, and necessary equipment downstream of the disconnect switch in the stand-by power building. The available power is 480 volt, 3 phase, 60 hertz. The disconnect and feeders provided are a 60 amp disconnect fused at 40 amps with #8 AWG feeders. Any changes in the disconnect or feeders shall be made at no additional cost to the Owner.

3.7 TESTING

The gondola system shall be tested by the Contractor in the presence of the gondola system manufacturer's representative and the Owner. The tests shall consist of the following.

A. Owner approved load test.

B. Verify tightness of all structural connections.

C. Verify lubrication of all moving parts.

D. Verify alignment and clearances of all open gearing.

E. Verify installation and alignment of all drive components.

F. Verify position and freedom of movement of counterweights or other tensioning means and carriages.

G. Verify haul rope alignment at entrance to bull wheels.

H. Verify operation of all electrical components, including circuit protection and grounding.
I. Verify track cable and haul rope sags under the most adverse static loads.

J. Verify alignment of track cable saddles and haul rope sheave units.

K. Verify evacuation equipment and procedures, including an actual test at the most difficult location.

L. Verify towers and terminals, for correct location and installation in accordance with Drawings and Specifications. Terminal and tower cable working points shall be documented by a record drawing survey, and any variation from the shop drawings shall be noted and approved by the manufacturer's representative.

M. Conduct thorough operating tests under full loadings that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. The functioning of all push-button stops, automatic stops, limit switches, and selected deropement switches shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings. Motive power and all braking shall be proved adequate under the most adverse loadings. The tests shall include at least 6 hours of continuous operation with an empty carrier to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

End of Section
SECTION 14C - CONTROL BUILDING VEHICLE

PART 1 - GENERAL

1.1 DESCRIPTION

This section includes furnishing and installing the vehicle for transporting equipment and materials from the interior of the Control Building to the exterior concrete slab.

1.2 QUALITY ASSURANCE

A. Manufacturers and Equipment... All materials and equipment shall be new, of the best quality, and made by nationally recognized and substantially established manufacturers. All materials and equipment shall conform to the latest standard specifications, ANSI, ASTM, etc. The work in this section shall be performed by journeymen, well-versed in the trades involved.

B. Source... All items in this section shall be furnished and coordinated by one manufacturer.

1.3 SHOP DRAWINGS

Shop drawings including operation and maintenance manuals shall be submitted in accordance with the General Requirements, Section 1D of these Specifications. Computations of sufficient detail to assure design conditions are met shall be included with the shop drawings and catalog cuts.

1.4 PRODUCT HANDLING

A. Protection... All means necessary shall be used to protect materials before, during, and after installation.

B. Replacement... In the event of damage, all necessary repairs and replacements shall be made to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 VEHICLE CHARACTERISTICS

A. Specific Design Requirements -

1. Direct Current electric operated.

2. Vehicle shall include all equipment required to recharge the vehicle batteries and compatible with the Control Building electrical system.

3. 24,000 pound capacity.

4. Capable of moving maximum load size 10' wide x 10' long x 9' high through 12' wide x 14' high opening.
5. Similar to Model CH-SP-E manufactured by Schreck by Plymouth.

PART 3 - EXECUTION

3.1 INSTALLATION

A manufacturer's representative, knowledgeable with this type of vehicle, shall be present during installation and start-up and testing. It shall be the representative's responsibility to direct the Contractor during installation of the vehicle.

3.2 START UP AND TESTING

Start-up and testing shall be conducted in the presence of the Owner. The Contractor shall perform any tests which might be recommended by the manufacturer, supplier, or Owner to determine that the vehicle meets all of the requirements of these Specifications.

All testing shall be performed solely at the Contractor's expense along with the replacement or repair of any equipment or materials damaged due to the use of unapproved test procedures or due to improper handling of vehicle during testing.

End of Section
SECTION 15A - MECHANICAL, GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

This section of the Specifications shall pertain to all mechanical sections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The provisions of Section 1A, General Requirements, along with all requirements and provisions of the bidding documents, including General Conditions, information or instructions for bidders, and supplements, are part of this division.

B. Examine all Drawings and all Specification divisions relating to the project. Include all work, materials and equipment mentioned or shown as being provided under this division. Refer to all contract Drawings and details in coordinating and completing work. Study all Drawings and Specifications to determine any conflicts with ordinances and statutes. Report any discrepancies, conflicts, or omissions; accomplish work required for conformance and/or completion.

1.3 WORK INCLUDED

A. Furnish and/or install all materials and equipment as specified in this division and/or shown on the Drawings relating to this division.

B. The Drawings and Specifications are complementary to each other. Include any work, materials, or equipment indicated on the Drawings but not described by the Specifications, or described by the Specifications but not shown on the Drawings, which is necessary for the completion of mechanical systems.

C. The Drawings show the general arrangement of ductwork, piping, equipment, and appurtenances. Follow Drawings as closely as actual building construction and the work of other trades will permit. Civil, Architectural, and Structural Drawings take precedence over mechanical Drawings. Because of the small scale of the Drawings, some offsets, transitions, fittings, and accessories which may be required have not been shown. The Contractor shall investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such fittings, transitions, offsets, and accessories as may be required.

1.4 MATERIALS AND EQUIPMENT

A. The contract is based on use of only those items of equipment or materials specified herein, shown on the Drawings, or as authorized by addenda. Items of material or equipment other than those specified may be proposed; however, such substitutions will not be considered unless complete and detailed information showing size, ratings, construction, and performance characteristics is submitted in accordance with the
General Requirements and General Conditions. Any equipment offered as a substitution shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, and shall satisfy the limitations of equipment arrangement, accessibility, and physical space of the equipment shown on the Drawings and/or specified. Substituted equipment shall be functionally compatible with all other components of the systems involved. The work shall include all necessary adjustments of such other components, and in the work of other trades, to ensure that all components of each system are fully compatible with each other.

B. It shall be the responsibility of the Contractor to ensure that "Bidder's Choice" products and alternate products conform to the Drawings and Specifications as to space requirements, performance, capacity, configuration, accessories, and materials of construction.

C. The Contractor shall be responsible for and bear the cost of all changes made necessary by the use of products other than those of the first-named manufacturer.

D. The Contractor shall be responsible to order equipment, and expedite delivery, to avoid delay in completion of the project.

1.5 PERMITS, LICENSES, FEES, ASSESSMENTS, AND INSPECTIONS

A. The Contractor shall obtain, pay for, and maintain all required permits, licenses, and certificates of inspection.

B. Arrangements shall be made by the Contractor for conducting all tests and/or inspections of work required for compliance with applicable codes and ordinances and any additional testing or inspection required under the contract. The Owner shall be notified of all tests and inspections not less than one week prior to the scheduled time and date.

1.6 CODES AND STANDARDS

A. Materials and workmanship shall comply with all applicable codes, Specifications, local ordinances, industrial standards, and utility company regulations. In case of difference between building codes, Specifications, state laws, local ordinances, industry standards, utility company regulations, and the contract documents, the most stringent shall govern.

B. Should the Contractor perform any work which does not comply with the above-described application of codes, standards, and the contract documents, he shall bear all costs arising from correction of the deficiencies.

C. Applicable codes and standards include the requirements and regulations of the National Fire Protection Association (NFPA), insurance underwriters, all state, county, and/or municipal jurisdiction enforcing agencies, and local or jurisdictional fire prevention bureaus and/or Fire Marshal. The work shall further conform to the applicable requirements of the following industry standards and Specifications:
Occupational Safety and Health Act (OSHA)
American Association of State Highway and Transportation Officials (AASHTO)
Air Moving and Conditioning Association (AMCA)
American National Standards Institute (ANSI)
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
American Society of Testing Materials (ASTM)
American Vater Vorks Association (AVVA)
National Electrical Manufacturers Association (NEMA)
Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA)
Underwriters’ Laboratories (UL)
Environmental Protection Agency (EPA)
Uniform Plumbing Code (UPC)
Uniform Mechanical Code (UMC)

1.7 SHOP DRAWINGS

A. Shop drawings shall be submitted in accordance with General Requirements, Paragraph 1.D and as follows. Shop drawings shall be submitted for all items listed in the "Products" sections of this division of Specifications.

1. Submit shop drawings for mechanical equipment wiring, mechanical equipment, and materials which cannot be adequately described by manufacturer’s printed sheets or catalog cuts, where required by other sections of this division, and for such additional items as the Owner may direct.

2. Submit material lists for such items as fittings, hangers, and supports.

3. Submit catalog cuts or manufacturer’s printed material for specialties; insulation; heating specialties; fans; ductwork; dampers; operators; and all other items not included on shop drawings or material lists.

B. Prior to submission, shop drawings, material lists, and catalog cuts or manufacturers’ printed data shall be thoroughly checked by the Contractor for compliance with contract requirements, accuracy of dimensions, coordination with work of other trades, and conformance with sound and safe practices as to erection or installation. Each submittal shall bear Contractor’s signed statement evidencing such checking and shall show corrections proposed, if any. The Contractor shall revise submittals requiring extensive corrections or replace before submission.

C. Clearly mark printed material, catalog cuts, pamphlets, or Specification sheets and shop drawings as to plan code, specific item proposed, catalog numbers, recess openings, dimensions, capacities, electrical characteristics, etc. Submittals which are incomplete will be rejected.

D. Contractor agrees that shop drawing submittals processed by the Owner are not change orders; that the purpose of shop Drawing submittals by the Contractor is to demonstrate to the Owner that the Contractor understands the design concept, that he demonstrates his understanding
by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents in the form of design Drawings and Specifications are discovered either prior to or after shop drawing submittals are processed by the Owner, the design Drawings and Specifications shall control and shall be followed.

1.8 COORDINATION

A. Before purchase or fabrication of any equipment or materials and before fabricating and/or running any lines of piping and ductwork, the Contractor shall determine that equipment will properly fit the space available and that piping and ductwork can be run as contemplated without interferences between systems, with structural elements, or with the work of other trades. The Contractor shall make proper and approved provisions for access to all equipment items and specialties for servicing, adjustment, and maintenance. The Contractor shall submit for review, when directed by the Owner, shop Drawings clearly showing the interrelationship of the various portions of the work, along with its relationship to the work of other trades prior to commencing fabrication or installation of the work. Failure to properly coordinate as defined herein may result in removal and/or relocation of equipment at no additional expense to the Owner.

B. Schedule the delivery of all large equipment assemblies requiring special openings for installation to be made prior to enclosing of the areas involved.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

Deliver to the Owner, in accordance with the General Requirements and the following (partial or incomplete data will be rejected):

A. Valve Directory.....2 copies, indicating valve number, size, location, function, and normal position for each valve.

B. Color Code Schedule.....2 copies, indicating colors used for identification of piping.

C. Nameplate Directory.....2 copies of list of all equipment nameplates, giving nameplate designation, manufacturer’s nameplate data, location of equipment, area served, plan identification code, switch locations, and normal position of switches.

D. Manufacturer’s Literature.....2 copies of manufacturer’s instructions for operation and maintenance of all mechanical equipment and specialties, including replacement parts lists and as-built wiring diagrams, on 8-1/2" x 11" sheets or catalogs, all suitable for side binding. Local representatives or service companies for each piece of equipment shall be noted, listing address and phone number.

E. Maintenance Instructions.....2 copies of typewritten instructions for
maintenance of the system, including: time schedule for maintenance work, listing each item of mechanical equipment requiring inspection, lubrication, or service, and describing the performance of such maintenance; list of all types of bearings for each piece of equipment with the type of lubricant required and frequency of lubrication; and sequence and flow diagrams for each of the systems, including emergency procedures, and normal starting, operating, and shutdown procedures. Instruct operating personnel in the care of the system in accordance with the approved typewritten instructions.

F. Binders.....Provide 2 looseleaf ring binders with permanent covers, separators with index tabs, and transparent looseleaf sheet protectors for the above data.

G. Shop Drawings and Submittals.....Provide 2 sets of Owner’s copies, in alphabetical order, in separate looseleaf binders.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials shall be new unless otherwise specified. Use the same brand or manufacturer for each specific application of motors, motor starters, valves, fittings, specialties, and equipment.

B. Properly align and statically and dynamically balance all rotating equipment for minimum vibration and operating noise levels, or as hereinafter specified.

C. All major equipment components shall have the manufacturer’s name, address, model number, and serial number permanently attached in a conspicuous location.

D. Provide for the safety and protection of all equipment or materials until final acceptance of the project, at which time all components of all systems shall be delivered in a clean and unblemished condition.

E. Provide protective guards for all exposed belt, chain, or gear drive systems, and for any exposed shafts fitted with projecting setscrews or keys. Provide access in guards for measurement of rotation speed. Guards and other safety provisions shall be in accordance with the requirements of OSHA.

2.2 MOTORS AND DRIVES

A. Motors -

1. Motors shall be as manufactured by Westinghouse, General Electric, or Owner approved equal. Each motor shall be at least of the horsepower specified and in addition shall be constructed for use at the altitude (7,000' A.S.L.) where the work is to be located with 1.15 service factor. Motors shall be provided with dustproof and leakproof bearing rings. Motors shall be guaranteed to operate continuously at 40°C ambient temperature and at full load with temperature rise in any part not to exceed NEMA standard. Motors shall be commercially, dynamically
balanced and tested at the factory before shipment and shall be selected for proper operation. Motors for v-belt drives shall be provided with a cast iron or steel base, with slide rail and adjustable screw device, as well as suitable belt guard. Line up motors and drives and place motors and equipment on foundations ready for operation.

2. Each motor shall be of squirrel cage type copper windings, Class F or H insulation, totally enclosed fan cooled. Motors shall have ball bearings.

3. Where commercially available, motors rated greater than 1000 watts shall have a power factor of not less than 85 percent under rated load conditions.

4. Lock rotor current of all motors 2 HP and larger shall not exceed that listed for NEMA Lock Rotor Indicating Code Letter H, (6.3 - 7.09 KVA/HP). Motors shall be furnished with thermal overload protection unless the electrical starting equipment provides thermal protection.

B. Belt Drives -

1. Belt drives shall have adjustable pitch sheaves with (except for two groove) companion driven sheaves. If fixed pitch sheaves are used, the Owner reserves the right to direct speed changes be made if in his opinion, these are warranted after final balancing. Fixed pitch sheaves shall be bushed type. Sheaves shall be cast iron. Two groove adjustable drive sheaves shall have a key for holding pitch adjustment. Belt drives shall be standard FHP, A, B, C, and D sections. FHP belt drives may be used for motors less than one horsepower. Select belt sections for all drives from applicable standard publications of the Rubber Manufacturers Association (RMA).

2. Belts shall be matched and sized for 150 percent of motor schedule horsepower. When A-B sheaves are used, use B section belts only.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND COMPLETION OF INSTALLATION

A. The Contractor, as well as his employees and subcontractors, shall be well-versed and skilled in the trades involved. The Contractors shall be wholly responsible for complete and proper installation of all work required for the project, including minor details not shown or specified as are necessary to complete the project.

B. Any changes or deviations from the Drawings and Specifications must be authorized in writing by the Owner before the change is made. Correct at no expense to the Owner all errors in installation, and repair all leaks in piping, equipment, and duct connections, including any resulting damage to work of other trades. Install all specialties as detailed on the Drawings. Follow approved manufacturer's recommendations where details or specific installation instructions are not provided.

C. Upon completion of the work, remove all litter, waste materials, unused
materials, and Contractor's tools and equipment from the job site. Check, lubricate, test, correctly adjust, and leave ready for proper use or operation as intended, all installed systems.

D. Close all pipe and duct openings with caps or plugs during installation. Protect all fixtures and equipment against dirt, water, and chemical or mechanical damage. At completion, thoroughly clean and remove all residue from interior surfaces. Clean exterior surfaces of all materials and equipment and deliver in perfect, unblemished condition.

E. Complete performance tests before release of any systems to the Owner for operation. Install all safety devices and request inspection and approval of same by authority having jurisdiction before placing related systems into temporary or permanent operation.

F. Provide a complete and properly operating installation, including all labor, materials, equipment, cartage, insurance, permits, assessments, and taxes. No claims for additional compensation will be allowed except where changes are approved in writing by the Owner.

3.2 EXISTING SERVICES

A. Carefully examine all of the Drawings and Specifications, visit the site of the work, and fully check all existing conditions, dimensions, and limitations prior to starting the work. Notify all companies or agencies owning, or having jurisdiction over, existing utilities and services which interfere in any manner with the execution of the work, and remove, reroute, or protect such utilities or services as required by parties having jurisdiction over same.

B. The Drawings indicate approximate locations and routings of known utilities or service systems. If other existing active or inactive systems are encountered which require relocation or disconnection, make a written request for decision on proper resolution of any interferences.

3.3 FOUNDATIONS, CURBS, AND BASES

Provide foundations, bases, and counterflashings for all equipment and systems requiring same. Concrete foundations, where installed on concrete floors, shall be dowelled to the floor to prevent lateral displacement. Lay out all dimensions and establish exact locations for foundations, curbs, and bases in coordination with shop drawings and the work of other trades. Minimum height of housecleaning pads shall be 4 inches with outside dimensions at least equal to those of the mounted equipment.

3.4 CUTTING AND PATCHING

A. Locate and verify all openings required in new construction for installation of the work and arrange with other trades for provision of same in the correct sizes and at proper locations. Failure to make such arrangements will cause the cost of cutting and patching to be borne by the Contractor, with all cutting and drilling to be performed by trades skilled in the work and in a manner approved by the Owner.
B. Specific review and approval are required for any cutting or drilling of load-bearing members.

C. Patching and trimming, where required, shall be accomplished by use of materials substantially matching adjacent surfaces in appearance and durability, with matching finish treatment.

3.5 PAINTING

A. Thoroughly clean and prepare for painting the surfaces of all equipment and materials. Painting will be performed under Division 9 of these Specifications except as otherwise indicated.

B. Where equipment, specialties, and apparatus are provided with factory finish either as the manufacturer's standard or as may be specified in this division, protect such factory finish throughout the construction period. Repair or touch up any blemishes to match original finish.

3.6 ESCUTCHEON PLATES

Provide chrome-plated brass or stainless steel escutcheon plates for all floor, wall, and ceiling pipe penetrations exposed in finished areas. Plates shall be split hinged, designed to fit the pipe and/or insulation and to cover projecting pipe sleeves.

3.7 SLEEVES, INSERTS, ANCHORS, AND SUPPORTS

A. Provide all required inserts, hangers, sleeves, fasteners, and fixtures needed to support and installation of the work. Embedded inserts, individual rod type or continuous channel with flanges or other provisions designed to provide secure anchorage, shall be provided for concrete construction where possible and where shown on the Drawings.

B. Provide pipe sleeves and duct frames where pipes or ducts pass through walls, floors, or ceilings. Pipe sleeves through nonbearing walls and partitions shall be 22 gage galvanized steel set flush with finished surfaces. Sleeves through floors and bearing walls shall be schedule 40 galvanized steel pipe. Annular clearance for sleeves shall be as follows unless otherwise indicated: not less than 3/16" nor more than 1" from surface of piping or insulation. Floor sleeves shall be watertight and shall extend 4" above floor. Sleeves penetrating vapor barriers shall be flashed watertight.

C. Support piping independently at pumps, coils, tanks, and the like so that piping weight will not be supported by equipment. Hangers, supports, and accessories shall be of sufficient strength to support the weight of the pipe and its contents.

D. Hangers for piping shall support the pipe and contents without piercing or crushing insulation. Provide insulation shields constructed of half-round pieces of galvanized sheet metal in the following lengths and gauges:
Pipe Diameter | Length | Gauge
--- | --- | ---
1/2" - 2-1/2" | 6" | 18
3" - 6" | 9" | 16
8" - 10" | 12" | 14
12" or Larger | 18" | 14

E. Provide anchors where required to localize expansion and prevent undue strain.

F. Hanger spacings and sizes shall conform to recommendations of the ASHRAE Guide and Data Book.

G. Except as otherwise specified or where specific supports are noted, support all suspended piping from approved hangers and steel rods. Pipe strap or perforated strap hangers will not be allowed.

H. Except as otherwise specified or where specific hangers, supports, and accessories are noted or detailed, standard catalog items of approved manufacture will be used for the hanging and support of piping systems.

I. The application of all hangers, supports, and accessories shall be in accordance with manufacturer's recommendations.

J. Approved manufacturers of pipe hangers, supports, and accessories are:

- Fee & Mason
- Elcen
- Grinnell
- Unistrut
- U.S. Expansion Bolt Company

3.8 MECHANICAL EQUIPMENT VIBRATION ISOLATION

Each item of mechanical equipment shall be isolated from the building structure through the use of properly designed vibration isolators and bases. The general guidelines shown in ASHRAE Handbook - 1976 Systems shall be used as a minimum standard.

3.9 WELDING

All welding shall be provided in accordance with the welding procedures of the National Certified Welding Bureau or other approved procedure conforming to the requirements of the ASME Boiler and Pressure Vessel Code, or the ASA Code for Pressure Piping. Only welders who have been fully qualified under the specified procedure shall be employed.

3.10 PIPE IDENTIFICATION

A. General....All new interior exposed piping shall be painted and color coded. The term "piping" includes all the pipe, fittings, valves, tanks, hangers, and other exposed metal accessories for the system to be painted.

B. Identification Scheme....The following scheme for the identification of
piping systems shall be used. The schedule indicates those systems for which the piping is to be a solid color and those systems for which the piping is to be banded. It also indicates those systems for which flow arrows and the name stencils are to be provided.

1. Bands....13-inch wide colored bands shall be located near strategic points such as valves, fittings, tees, intersection with walls, etc.

2. Flow Arrows.....Flow arrows shall be stenciled beside each band indicating the direction of flow through the pipe. Arrows shall be placed in such a location on the perimeter of the pipe to be readily visible to operating personnel from the floor of the area. The arrow shall be the same color as the band, approximately 4" long, 2" for the shaft and approximately 2" for the head. The head shall be formed by an equilateral triangle having a base equal to twice the width of the shaft. The width of the shaft shall be one inch, except on pipes 3 inches or less in diameter, when it shall be 1/2 inch.

3. Name Stencils.....A lettered legend shall be stenciled in black to further identify the pipe contents for the systems indicated in the schedule. Lettering shall be stenciled in the band on the lower quarters of horizontal piping. Size of letters shall be as follows:

<table>
<thead>
<tr>
<th>Insulation or Pipe Diameter</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; - 3/4&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>1&quot; - 1-1/4&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>1-1/2&quot; - 2&quot;</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; - 3&quot;</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>3-1/2&quot; or Larger</td>
<td>1-1/2&quot;</td>
</tr>
</tbody>
</table>

PIPING IDENTIFICATION SCHEME

<table>
<thead>
<tr>
<th>Clarification</th>
<th>Pipe Color</th>
<th>Band Color</th>
<th>Name Stencil</th>
<th>Flow Arrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>Red</td>
<td>None</td>
<td>LPG</td>
<td>Yes</td>
</tr>
</tbody>
</table>

C. Provide tags for all valves identifying type of service. Install identifying tags for all valves installed on branch mains or risers identifying type of service and areas served. Tags for equipment and piping shall be of aluminum or brass, 1-1/2" in diameter with smooth edges, punched for tie wire attachment. Captions shall be stamped into the metal surface.

Provide stencil or engraved bakelite names for magnetic starters, relays, manual operating switches, disconnect switches, thermal overload switches, automatic controls, control panels, thermometers, and thermostats to identify connecting or controlled equipment or function.

3.11 EXCAVATION AND BACKFILL

Backfill and excavations shall be performed in accordance with Division 2 of these Specifications.
### 3.12 MECHANICAL EQUIPMENT WIRING AND CONNECTIONS

A. Furnish, set in place, and wire, except as may be otherwise indicated, all heating and ventilating motors and controls in accordance with the following schedule. (Carefully coordinate with work performed under the Electrical Division of these Specifications.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Furnished By</th>
<th>Set In Place By</th>
<th>Wired Power</th>
<th>Wired Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Motors</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>*Magnetic Motor Starters:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Automatically Controlled, with or without HOA Switches</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>2) Automatically Controlled, with or without HOA Switches and which are furnished as part of factory wired equipment</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>3) Manually Controlled</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>4) Manually Controlled, and which are furnished as part of factory wired equipment</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Pushbutton Stations, Pilot Lights</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Disconnect Switches, Thermal Overload Switches, Manual Operating Switches</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>-</td>
</tr>
<tr>
<td>Contactors</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Wall Mounted Electric Thermostats, and Humidistats</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Air Flow Switches, Remote Bulb Thermostats, Duct Thermostats, etc., included in the building temperature and humidity control systems.</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>M</td>
</tr>
<tr>
<td>Damper Motors, Etc.</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>M</td>
</tr>
<tr>
<td>Electric Heating Elements, Control Panel, Staging Contactors, Etc.</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Temperature Control Panel</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
</tbody>
</table>

M - Mechanical Division  
E - Electrical Division
*Starters which are to be furnished under the Mechanical Division shall be in accordance with the Electrical Division of these Specifications.

B. Complete wiring diagrams for equipment and systems in this division for installation purposes shall be furnished under the Mechanical Division.

C. All line and low voltage wiring shall be installed utilizing materials and methods as specified in the Electrical Division of the Specifications.

D. Provide NEMA rated motors and equipment suitable for operation on the voltage systems as designated below with tolerances for the allowable voltage variations above and below the nominal. Locked rotor current of all motors 2 HP and larger shall not exceed that current listed for NEMA locked rotor indicating code letter "H", (6.3 - 7.09 KVA/HP).

<table>
<thead>
<tr>
<th>Service Voltage and Phase</th>
<th>Rated Motor Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>277/480, 3Ø</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>460</td>
</tr>
</tbody>
</table>

E. Verify the available voltage and phase characteristics for each motor before ordering any motors. All motors shall be provided having voltage and phase characteristics as indicated on the electrical Drawings. The above table shall be used as a guide only.

3.13 TEMPORARY HEAT

All heating required during construction shall be furnished by Contractor. All energy costs shall be paid for by the Contractor. All utility connections shall be paid for as specified herein. Temporary heating units shall conform to safety codes and local and federal ordinances. No equipment or systems installed as part of the project shall be used for temporary heating, ventilation, or cooling except as may be specifically authorized by the contract documents or as authorized by the Owner’s representative. Where such use is permitted, the Contractor shall, prior to final acceptance of the project, service, repair, or replace all components to restore them to new condition (including cleaning or replacing air filters). Flush and clean pipes and duct systems, and prepare all exterior surfaces for painting.

3.14 FINAL ADJUSTMENTS

A. Check equipment for proper operation and complete final adjustments prior to performance tests and prior to final observation and acceptance of the project.

B. After final acceptance, make, upon request, such further adjustments as necessary to obtain satisfactory performance of systems.

C. Flows in the air distribution systems shall be balanced, as soon as the condition of the installation permits. See other sections for specific requirements.

End of Section
SECTION 15B - MECHANICAL, PLUMBING
----------------------------------------

PART 1 - GENERAL
----------------------------------------

1.1 DESCRIPTION
-------------
This work shall consist of performing all labor, furnishing, and testing all material, fixtures, piping, and equipment necessary for a complete and operational plumbing installation as shown on the Drawings and specified herein, including:

- Sump pump
- Drain piping
- LPG piping
- Sump pump piping
- Sump pump float switches
- Unions
- Flexible couplings
- Valves
- Flashings
- Drains
- Level Sensing Piping

1.2 CONDITIONS
-----------
The conditions shall be as specified in the General Requirements and General Conditions of these Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE
-----------------------------------------------
A. General Provisions: Section 15A.

1.4 UTILITY CONNECTIONS AND SERVICES
-----------------------------------------------
Furnish sleeve through foundation walls where required for building services and make watertight.

PART 2 - PRODUCTS
----------------------------------------

2.1 WASTE AND VENT PIPING
-----------------------------
A. Piping within building shall be service weight, cast iron soil pipe, ASTM 74, copper CWV ASTM B-306, or Schedule 40 galvanized steel ASTM A-120.

B. Fittings and joints shall be as follows:

1. Cast Iron....Elastomeric compression type or No-Hub.
2. Copper.....95-5 solder.
3. Steel.....Screwed cast iron or galvanized malleable drainage fittings.
2.2 LPG PIPING

---
A. All LPG piping.....Black steel pipe, schedule 80, ASTM A120-78.
B. Fittings and Joints.....Screwed 250 lb. malleable iron, or higher pressure class as required at tank connections.

2.3 SUMP PUMP PIPING AND LEVEL SENSING PIPING

---
A. Sump discharge piping shall be Schedule 40 galvanized steel ASTM A-120.
B. Level sensing piping from control building to intake structure and along dam face shall be Schedule 40 galvanized steel ASTM A-120.
C. Fittings and joints shall be as follows:
   1. Steel Piping.....Malleable iron screwed fittings.

2.4 SUMP PUMP

---
Sump pump shall be completely submersible with separate external float switch to automatically cycle the pump. Motor shall be 1 horsepower, 460V, 30, 60 cycle. Pump shall be complete with combination magnetic starter with control transformer, 15' of 14/4 S0 cable power cord, cast iron impeller, and 2" diameter discharge. Motor bearings shall be ball type and lubricated for life service.

Sump pump shall deliver a minimum of 75 GPM against a head of 28 feet.

Sump pump shall be as manufactured by Peabody-Barnes, Model 3SE104, or Owner approved equal.

2.5 FLOAT SWITCH ASSEMBLIES

---
Level detecting device shall be type 316 stainless steel, or steel encapsulated in polyurethane, float with a mercury switch inside. Float switch shall be flexibly supported by a heavy-duty neoprene type SJ0 cable. The mercury switches shall be rated 25 amps at 115 volts. Float cable shall have #16 AWG stranded copper conductors.

Switch assembly shall be securely fastened to the sump discharge pipe with type 316 stainless steel hardware.

The float switches shall operate as follows:
   High limit/low limit switch shall provide pump-down control of the sump pump.
   High water level alarm switch shall be electrically independent of the pump control. Level alarm switch conductors shall be terminated in the telemetry control panel in the control building.

2.6 VALVES

---
Valves shall be designed for service intended with packing and seat as
recommended by the valve manufacturer or as specified herein. The Contractor shall standardize on one brand as much as practicable but not to the extent of sacrificing quality for use of a specific duty. Valves shall be full line size and have a pressure drop across the valve of less than 1 pound.

A. Boiler.....300 pound, 3/4" inlet threaded, 3/4" male iron pipe thread only -- outlet with standard hose thread. A McDonald 3598 or Owner approved equal. Provide boiler drain with 3/4" welding fitting of the same class steel as the main lines in the control building for attachment to pipe.

B. Gas Cock.....Under 1-1/4": High pressure gas service, bronze body, square head stop with check pin, flag way, standard pattern.

C. Gate Valve.....2" and smaller: 125 pound SWP, rising stem, solid gate.
  1. Steel Piping.....Threaded ends, steel body.
  2. Copper Piping.....Soldered ends, bronze body.

D. Check Valve.....2" and smaller: 125 pound SWP, horizontal swing, renewable disc and seat. LPG check valves: 600 pound class.
  1. Steel Piping.....Threaded ends, steel body.
  2. Copper Piping.....Soldered ends, bronze body.

2.7 UNIONS
-------
A. 2" and Smaller.....150 lb., screwed, malleable iron, bronze-to-iron ground joint.

B. Dielectric.....EPCO, or equal.

C. LPG Unions.....250 lb.

2.8 FLEXIBLE COUPLING
---------------------
Flexible coupling shall be as follows:

A. Steel Piping.....Flexible couplings shall be full line size stainless steel hose and braid covering; ends shall be carbon steel male pipe thread; length shall be minimum 12 inches long; flex coupling shall be model KFCS-MPT by Keflex or Owner approved equal. 250 lb. class minimum for LPG gas service.

B. Copper Piping.....Flexible coupling shall be full line size bronze hose and braid covering; ends shall be female copper tube; length shall be minimum 12 inches long; flex coupling shall be model KFCB-CTF by Keflex or Owner approved equal.

2.9 FLASHINGS
-------
All drains, floor cleanouts, and sleeves penetrating concrete floors
shall be installed with clamping devices. A flashing shield shall be inserted into the clamping device and made watertight. Flashing shield shall be made from sheet-lead not lighter than 4-pound and extended not less than 8" from the drain, cleanout, or sleeve in all directions.

2.10 FLOOR DRAINS

Drains shall be 4" Ø outlet, heavy-duty, with sediment bucket, bottom outlet, and tractor grate, Smith #2233 or Owner approved equal.

Sediment bucket shall be removable to allow direct access to drain pipe.

PART 3 - EXECUTION

3.1 PIPING SYSTEM

A. Cut all pipe accurately to measurement taken at the job site and work into place without springing or forcing.

B. Make allowance throughout all piping systems for expansion and contraction.

C. Grade all piping to permit drainage of entire system. Install valves for system drainage at all low points.

D. Run horizontal drainage piping with straight alignment and at a uniform slope of not less than one-eighth (1/8) inch per foot. Support from the building structure shall be at not more than five (5) foot intervals or as indicated on the Drawings.

E. Obtain written permission from the Owner before cutting or drilling the building structure to facilitate piping or equipment installation.

F. Remove all pipe and tubing burrs by reaming.

G. Make all piping direction changes with fittings, except for buried exterior LPG piping in which no joints shall be allowed.

H. Cap or plug open ends of all piping and equipment during installation to prevent foreign materials from entering the systems.

I. Furnish and install unions at all fixture and equipment connections.

J. Isolate connections between ferrous piping and copper piping with dielectric unions or fittings.


L. Provide a gas cock and union at each appliance and at building entry.

M. All LPG piping installation shall conform to the requirements set forth in NFPA No. 58, liquified petroleum gases.

N. Install boiler drains on the main pipe as indicated on the Drawings.
All connections to the main pipe shall be made with full size welded fittings, or 300 lb. class screwed fittings.

0. The 1/2"Ø level sensing lines shall extend from the control building to the intake structure and up the concrete face of the dam as indicated on the Drawings.

3.2 SUMP PUMP

Install sump pump as shown on Drawings and as recommended by manufacturer for complete installation and proper operation.

3.3 FLOAT SWITCH ASSEMBLY

Float switch assembly shall be installed for proper operation as indicated. Sump pump control and alarm initiation shall be installed and tested per Division 16 of these Specifications.

3.4 FLEXIBLE COUPLING

Install flexible coupling as shown on Drawing and as recommended by manufacturers of equipment.

3.5 FLASHINGS

All drains, floor cleanouts, and sleeves penetrating concrete floors shall be installed with clamping devices. A flashing shield shall be inserted into the clamping device and made watertight.

3.6 TESTING - PIPING SYSTEMS

A. All piping and connections installed under this contract shall be tested prior to painting, placing of any backfill, installation of nonconducting covering, or concealment within the building construction. Each test shall be performed as specified herein and shall be continued or repeated until the lines under test are proven tight to the satisfaction of the Owner.

Requests for inspections shall be made by the Contractor for all interior roughing-in of pipe prior to concealment of same and also for final inspection upon completion of work.

Sections of the system may be tested separately, but when so tested it shall be distinctly understood that any defect which may develop in a section already tested and accepted shall be corrected and retested. Controls, valves, and equipment not able to withstand test pressures shall be removed from the system during test.

B. The new water supply system shall be subjected to a hydrostatic test of not less than that specified for the main supply pipe. This pressure shall be maintained for the period specified for the main pipe after expiration of which, if the lines prove tight, the pressure may be reduced to the normal pressure for the building.

C. The entire sewer system, which includes all soil, waste, drain, and vent
piping, shall be tested with water. Water tests shall have been completed prior to the final connection of any fixture to the sewer system.

All the drainage system below the floors shall be filled with water to the top of a vertical section of pipe not less than ten (10) feet high, temporarily connected to the highest point of the lines to be tested. The water shall be allowed to stand not less than eight (8) hours after expiration of which if the lines prove tight, i.e., if the water level has remained constant, they shall be drained.

These tested lines shall then be immediately connected to the sewer, and the trenches backfilled. The soil, waste, drain, and vent piping above the ground or floor level shall have the openings plugged where necessary, and shall be filled with water to the level of the top vent pipes. The water shall be allowed to stand not less than eight (8) hours, after expiration of which, if the lines prove tight, i.e., if the water level has remained constant, they shall be drained and the fixtures connected. When the branch waste and vent pipes are tested separately, a plug shall be inserted in the cleanout at the base of each vertical stack being tested, in lieu of filling the entire system in the building.

D. Test all LPG piping to 200 psi. Compressed nitrogen shall be used for test. Test pressure shall be held without additional filling for at least 2 hours without showing any drop in pressure. Test all joints and fittings with a soap solution.

E. No pipe or joint shall be left untested.

F. All tests shall be performed in the presence of the Owner or authorized representative.

G. All leaks found shall be repaired and the pressure test repeated as specified above until tightness requirements are met, with no additional cost to the Owner.

3.7 CLEANING AND ADJUSTING
--------------
A. After completion of tests, flush all piping systems and clean all equipment, piping, valves, and fittings.

B. Adjust all valves. Disassemble and clean if required.

3.8 UNDERGROUND PIPE PROTECTION
-----------------------------
Protect all underground LPG piping as follows:

Tape Wrap: Pipe shall be thoroughly cleaned in strict accordance with manufacturer's instructions before tape is applied. Tape shall be pressure sensitive, adhesive backed, polyvinyl chloride or polyethylene and shall be applied in strict accordance with manufacturer's instructions, with the correct type and amount of liquid adhesive primer. Straight pipe shall be spirally wrapped with 0.020" thick tape. Overlap on successive wrapper passes shall be at least one-half of the
width of the tape.

3.9 BALANCING AND ADJUSTMENT

A. Examine all piping systems to see that installation has been made in accordance with design flow diagrams, that all valves and gauges have been installed, that systems and strainers have been cleaned, that all moving equipment has been lubricated, and perform other inspection and maintenance activities necessary for proper operation of all systems.

B. Adjust all piping circuits for design flows.

3.10 FINAL ACCEPTANCE TESTS

A. After completion of balancing and adjustment, perform operational tests of all LPG systems for a period of not less than 4 hours to demonstrate satisfactory operation of equipment and controls.

B. Conduct all tests in the presence of the Owner or authorized representative.

End of Section
SECTION 15C - MECHANICAL, INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION
This work shall consist of furnishing and installing all insulation as specified in this section and/or as indicated on the Drawings pertaining to this division.

The work covered by this section shall include but not be limited to furnishing and installing insulation on the following:

- Exterior surfaces of supply air plenums and ducts as indicated on the Drawings.
- Generator exhaust piping and muffler.
- Sheet Metal Jacketing - for all duct, equipment, and engine exhaust pipe insulation.

1.2 CONDITIONS
The conditions shall be as specified in the General Requirements and General Conditions of these Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE
A. General Provisions: Section 15A.
B. Heat Generation: Section 15D.
C. Air Distribution: Section 15E.
D. Temperature and Ventilation Control: Section 15F.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Duct and Equipment Insulation.....Certainteed Corp.; "Industrial Insulation Board" IB600, with All-Service reinforced vapor barrier, or Owner approved equal.

B. Engine Exhaust Insulation.....Manville Corp.; "Thermo-12" Pipe and block insulation, calcium silicate, and Owner approved equal.

C. Sheet Metal Jacketing - All Insulations.....0.016" thick aluminum sheet or galvanized steel. Manville Corp.; "Metal-On" System, or Owner approved equal, where applicable.

2.2 GENERAL
All insulation materials shall be noncombustible as defined in NFPA No. 220 and shall be UL listed and labeled.
Chemicals for treating paper in jacket laminates shall not be water soluble and shall be unaffected by water or humidity.

Approved manufacturers of insulation materials are: Manville, Owens-Corning, Armstrong, Certainteed, PPG Industries, CSG, BEH, Inc., or Owner approved equal.

All adhesives, sealers, facings, and vapor barriers and coatings shall be compatible with materials to which applied and shall not corrode, soften, or otherwise attack the pipe, duct, or insulation materials in either the wet or dry state. Use only adhesives, sealers, and vapor barrier coatings as recommended by the approved manufacturers of insulation materials.

Vapor barrier coatings shall have a perm rating not more than 0.25. Vapor barriers shall have a perm rating not more than 0.02.

Presized glass cloth shall be mildewproof and weigh not less than 7.8 ounces per square yard when used as jacket material.

Maximum thermal conductivity for various types of insulation shall conform to the following table:

<table>
<thead>
<tr>
<th>Type of Insulation</th>
<th>Maximum Thermal Conductivity/In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Fiber Rigid Equipment Insulation</td>
<td>0.37 at 200°F</td>
</tr>
<tr>
<td>Glass Fiber Rigid Duct Insulation</td>
<td>0.24 at 75°F</td>
</tr>
<tr>
<td>Calcium Silicate Block &amp; Pipe Insulation</td>
<td>0.60 at 600°F</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. All testing of piping and ductwork shall be completed prior to application of insulation.

B. All insulation shall be applied tightly over clean, dry surfaces with all sections or edges firmly butted together.

C. Vapor barriers shall be sealed and run continuously throughout all systems. Those systems 25 feet or longer in total developed length shall have the insulation sealed off with vapor barrier at 20-foot intervals.

D. Avoid the use of staples on vapor barrier jackets. If staples must be used, thoroughly seal all vapor barrier penetrations with a white vapor barrier finish.

E. All insulation surfaces shall be left clean.

F. It is the intention of this Specification to insulate and provide a continuous vapor barrier on all systems described herein.
3.2 SPECIFIC INSTALLATION REQUIREMENTS

A. Ductwork and Fan Housings.....Insulate exposed ductwork with 2" thick glass fiber rigid insulation with white Du-All vapor barrier facing. Secure insulation to surfaces with a full surface coat of adhesive and mechanical fasteners (welded pins or studs and washers). Tape all breaks, joints, seams, and pin penetrations with manufacturer recommended tape adhered with vapor barrier lap adhesive. Thoroughly seal the vapor barrier prior to installation of sheet metal jacketing. Install sheet metal jacketing over all insulation materials, secured in place in accordance with manufacturer’s recommendations.

B. Generator Engine Exhaust.....Insulate exhaust piping and muffler inside the Standby Power Building with calcium silicate pipe and/or block insulation, thickness as required for maximum surface temperature of 150°F. Cover with Manville "Metal-On", or Owner approved equal, sheet metal jacketing.

End of Section
SECTION 15D - MECHANICAL, HEAT GENERATION

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of performing all labor and furnishing and testing all materials and equipment for a complete heating system. The work covered by this section shall include but not be limited to furnishing and/or installing and testing the duct heaters.

1.2 CONDITIONS

The conditions shall be as specified in the General Requirements and General Conditions of these Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. General Provisions: Section 15A.
B. Air Distribution: Section 15E.
C. Temperature and Ventilation Control: Section 15F.
D. Electrical: Division 16.

PART 2 - PRODUCTS

2.1 DUCT HEATERS

Duct heaters shall be open-coil slip-in type, totally self-contained units ready for installation. Duct heaters shall incorporate disconnects, contactors, fusing, overheat protection, airflow switch, terminal blocks, and all other equipment and wiring necessary for a complete and operating heat system in conjunction with heating and dehumidification systems. Duct heaters shall operate in accordance with sequence of operations as shown on Drawings. Duct heaters shall be INDEECO, Type QUA, 40 KW, 480V, 3 phase, 3 stage, 30 inches wide by 24 inches deep, or Owner approved equal. Each stage shall have separate contactors with 120V coil. Disconnects and contactors shall break all ungrounded conductors. Verify all electrical characteristics with Electrical Division.

2.2 UNIT HEATER

Horizontal unit heater shall have a heating delivery capacity of 12,600 BTU/Hour, 3.7 kw. A mounting bracket designed for wall swivel mounting shall be furnished. The cabinet shall be of 18 gauge, die formed, furniture grade steel. Individual adjustable louvers shall be furnished to provide control of discharge air. All metal surfaces shall be phosphate coated and finished in neutral grey baked enamel.
The electric heating bank shall consist of metal sheath fintube heating elements. Automatic reset thermal over-head protection shall be wired for instantaneous pilot operation of built-in 120V control contactor holding coil. Provide integral 120V control transformer.

Motors shall be of the totally enclosed continuous fan-duty ball bearing type equipped with built-in thermal overload protection.

Fans shall be aluminum, direct drive, and dynamically balanced.

The Unit Hater shall be U.L. listed and meet the requirements of the National Electric Code; and shall be as manufactured by Emerson-Chromalox, Horizontal Unit Heater, 208V 30, Model MUH-05-02, or an Owner approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Heaters.....Duct heaters shall be installed at the locations indicated and as detailed on the Drawings. All duct heaters shall be installed in accordance with manufacturer’s recommendations, with the National Electric Code, and with applicable portions of Division 16 Specifications. Installation shall be complete and provide operation in accordance with the Sequence of Operations.

B. Unit Heaters.....Unit heaters shall be installed at the locations indicated and as detailed on the Drawings. All unit heaters shall be installed to comply with manufacturer’s recommendations, with the National Electric Code, and with Division 16 Specifications. Installation shall be complete and operational.

End of Section
SECTION 15E - MECHANICAL, AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of performing all labor and furnishing all materials and equipment for a complete air distribution system.

1.2 CONDITIONS

The conditions shall be as specified in the General Requirements and General Conditions of these specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. General Provisions: Section 15A.
B. Insulation: Section 15C.
C. Heat Generation: Section 15D.
D. Temperature and Ventilation Control: Section 15F

1.4 WORK INCLUDED

A. Furnish, install, and test all equipment, ductwork, and sheet metal specialties as specified in this section and/or as indicated on the drawings pertaining to this division.

B. The work covered by this section shall include, but not be limited to, furnishing and installing the following materials:

   Supply Fan
   Exhaust Fan
   Sheetmetal Ductwork and Plenums
   Balancing
   Filters
   Turning Vanes
   Manual Dampers
   Grilles

PART 2 - PRODUCTS

2.1 SUPPLY FAN, EXHAUST FAN

A. Loren Cook Company, Model CJA, size E45 (24-1/2" diameter fan wheel), all aluminum construction, discharge arrangement as indicated; or Owner approved equal.

B. Capacity -

   5,000 CFM @ 2" S.P.
   980 RPM
   3 HP Motor
C. Features –

1. Fixed pitch type drive, sized for scheduled air flow.

2. V-belt drives designed for not less than 150% of the connected driving capacity.

3. Sheaves with motor mount adjustment to allow 25% speed variation.

4. Belt guard and lifting lugs.

5. All aluminum construction.

D. Motor –

1. Totally enclosed fan cooled, and in accordance with Section 15A, General Provisions.

2. Motors shall be lubricated for a minimum of five years' service.

2.2 FILTER

Filter housing shall accommodate a 4" moisture eliminator and 2" filter. Housing shall be factory fabricated and assembled, constructed of not less than 16-gage galvanized steel. Unit shall incorporate access door. Extruded aluminum tracks, and individual universal holding frames designed to accommodate FARR type 44 filters, and type 64MZ moisture eliminator. Complete unit shall be FARR, or Owner approved equal.

2.3 SHEET METAL DUCTWORK, CASING, AND PLENUMS

All ductwork, casings, and plenums shall be constructed of sheet metal in accordance with SMACNA Duct Construction Standards, latest edition.

Control Valve Inlet Hood Duct shall be 16 gauge, reinforced to SMACNA 4" W.G. pressure class.

Heating, Ventilating, etc. ductwork shall be 16 gauge, reinforced to SMACNA 2" W.G. pressure class.

2.4 TURNING VANES, MANUAL DAMPERS, ETC.

Duct accessories shall be heavy duty, suitable for applications intended, and compatible with surrounding ductwork where installed.

2.5 GRILLES (SAG)

Supply Air Grilles (SAG) shall be of the size indicated on the Drawings and shall be Metal-Aire, Mode 2000H Bar Grille, or Owner approved equal. Provide mounting arrangement for secure installation; no snap-in retainers shall be allowed.
PART 3 - EXECUTION

3.1 INSTALLATION - AIR DISTRIBUTION SYSTEMS

A. Sheet metal ductwork, casings, and plenums, except as otherwise specified, noted, or detailed, shall be installed in strict accordance with the SMACNA Duct Construction Standard, latest edition and shall be used as the air distribution materials in the control building.

B. All horizontal ducts shall be substantially supported from floor or walls and properly braced as detailed or where not detailed so there will be no sagging of top or bottom.

C. All changes in direction, width, or depth of ducts shall be made gradually, at an angle of 15°F whenever applicable.

D. Equipment -

1. Fans shall be checked, and corrected as required, for proper dynamic balance, after installation.

2. Set all equipment true and level.

3. Install supports for all equipment, appurtenances, and specialties as specified or as indicated on the drawings. Where not specified or detailed, install supports in accordance with manufacturer's installation instructions.

4. Align all motors with their belt-driven equipment.

5. Lubricate all bearings and tighten all belts in accordance with manufacturer's recommendations before startup.

E. Access Doors -

1. Install access doors at all automatic dampers and manual dampers, except where accessible directly without disassembly.

2. Adequately size all access doors to properly service equipment for which access is being provided. Locate access doors on the correct side of the equipment to be serviced. Construct in strict accordance with the SMACNA High Velocity Duct Construction Standards Manual, latest edition.

F. Machinery Guards.....Install guards for all belts, sheaves, and accessible fan openings. Provide access hole in fan sheave guard to provide for measurement of fan speed.

G. Flexible Duct Connections......Install high pressure, flexible duct connectors of flame-retarded fabric at all connections of ductwork to fans and where indicated on the drawings.

3.2 CLEANING

Remove all debris and clean all interior and exterior surfaces of ductwork, plenums, equipment, and specialties.
3.3 TESTING

A. Water and electricity required for the tests will be furnished by the Contractor. Any material, equipment, instruments, and personnel required by the tests shall be provided by the Contractor.

B. All supply, return and exhaust ducts, plenums, and casings shall be tested and made substantially air-tight before covering with insulation. Substantially air-tight shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing at all duct joints, when pressurized to 3 inches water column.

3.4 BALANCING

A. General Requirements -

1. Examine all air distribution systems to see that they are free from obstructions. Determine that all dampers are in their proper operational positions, that moving equipment is lubricated, that filters are clean, and perform other inspection and maintenance activities necessary for proper operation of the system.

2. Demonstrate that the fans perform as specified. Adjust dampers and replace drives and belts as necessary to obtain specified air quantities.

3. Adjust grilles to distribute the air. Each grille shall deliver or remove the designed CFM in the proper pattern.

4. Tabulate the results of all testing on forms similar to the SMACNA Apparatus and Outlet Test Reports and submit four copies to the Owner for approval and record.

5. Provide information regarding all air flow and rotating speed measuring instruments, i.e., type, manufacturer, date of last calibration, and any correction factors required or used.

B. Specific Requirements -

1. Use pitot tube traverse method to measure fan capacities.

2. Replace drives and belts as required to adjust fan capacities.

3. Do not allow any fan to run so that the fan motor exceeds its full load nameplate amperage rating.

4. Adjust all fans and air handling units to within 5% of specified air quantities.

5. Check all fans for vibration. The maximum vertical, horizontal, and axial displacement allowed for any fan is 2 mils. Correct as necessary.

6. Mark and secure with sheet metal screws all damper quadrants in their final balanced positions.
7. Observe temperature control operation of all air distribution systems and report any discrepancies in the balance report.

8. Include a report to show that all instruments used for testing and balancing air systems have been calibrated within a period of six months and check for accuracy prior to start of work.

9. The calculated design conditions for each fan are tabulated below with their respective operational modes. The fans shall be set to deliver 5,000 CFM each against their greatest static pressure. The alternate operational mode of each fan shall be fitted with restrictions or damper throttling as necessary to bring the total fan output down to 5,000 CFM.

<table>
<thead>
<tr>
<th>Supply Fan - 5,000 CFM</th>
<th>Dehumidification</th>
<th>SP = 2.0&quot; W.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Building Heating</td>
<td>SP = 0.7&quot; W.G.</td>
</tr>
</tbody>
</table>

| Exhaust Fan - 5,000 CFM | Dehumidification | SP = 1.3" W.G. |

C. Air Balancing Contractor -

1. Air balancing shall be performed by a specialist whose business is limited to the testing and balancing of air-conditioning systems.

2. This balancing Contractor shall have proof of having successfully completed at least three projects of similar size and scope.

End of Section
SECTION 15F - MECHANICAL, TEMPERATURE AND VENTILATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION
This work shall consist of performing all labor and furnishing all materials and equipment for a complete heating, ventilating, and air distribution control system.

1.2 CONDITIONS
The conditions shall be as specified in the General Requirements and General Conditions of this set of Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE
A. General Provisions: Section 15A.
B. Heat Generation: Section 15D.
C. Air Distribution: Section 15E.
D. On-Site Power Generation: Section 16E.
E. Instrumentation and Control Equipment: Section 16F.

1.4 WORK INCLUDED
A. The automatic temperature control systems in the control building shall be basically electric as described in the sequence of operations on the Drawings. The temperature control system in the control building shall function in accordance with the sequence of control. The systems shall be complete in every respect, put in operation, and adjusted under operating conditions.

B. The systems shall include all control devices, damper actuators, and automatic dampers, fittings, wire, conduit, etc., as specified and required and connected so as to perform all functions and operate according to the sequence specified. Provide a complete system without duplication or omission. The control building system shall be coordinated through the mechanical control contractor to assure the compatibility of temperature controls with the mechanical equipment and all control wiring.

1.5 SHOP DRAWINGS
Submit complete engineering shop drawings including control schematic diagrams, control wiring diagram, damper and operator schedule, control panel layout, and complete descriptive narrative of the sequence of operation which must be approved by the Owner prior to installation. Provide an approved submittal to the electrical contractor and any other related contractor.
PART 2 - PRODUCTS

2.1 THERMOSTATS

A. General. All thermostats shall be 120 VAC, fully proportional, single pole double throw, unless specified otherwise and shall be room, remote bulb or rigid bulb, or transmitter and receiver type. Averaging bulbs shall be used in coil discharge locations.

All thermostats shall be industrial type and shall be fully enclosed with metal guards. All thermostats shall be full load rated at a minimum of 5 amps at 120V.

All thermostats shall be functionable over ambient temperature range of 20°F to 120°F, except remote bulb thermostat which shall function over ambient temperature range of -30°F to 120°F. Setpoint control temperature range may be less in accordance with sequence of operations.

In addition to the requirements of the specifications, all thermostats shall be as shown on drawings and operate in accordance with the sequence of operations.

B. Discharge Air Temperature Sensor. Discharge air temperature sensors shall be averaging, fast response, remote bulb thermostats for duct mounting and shall have adjustable temperature control range of at least 40°F to 120°F. Discharge air sensor for dehumidification shall be model T678A1437, discharge air sensor for heating shall be model T675A1706 by Honeywell or Owner approved equal.

C. Room Thermostats -

1. Thermostat 35°F Setpoint and 45°F Setpoint. Thermostats shall have adjustable setpoint of 0°F to 70°F and shall be model T631A1030 by Honeywell or Owner approved equal.

2. Thermostat 100°F Setpoint. Thermostat shall have adjustable setpoint from 70°F to 140°F and shall be model T631A1105 by Honeywell or Owner approved equal.

2.2 HUMIDISTAT

Humidistat shall be industrial type with metal cover, 120 VAC, adjustable from 10% RH to 80% RH. Humidistat shall be full load rated at a minimum of 5 amps at 120 VAC.

Humidistat shall be model BAH-71 or BAH-71X by Byr-Air Co. or Owner approved equal.

2.3 DAMPERS

Provide all automatic dampers and actuators to conform to the following specifications:

A. General -
1. Damper frames shall be 1/8" galvanized steel channel or 0.125 extruded aluminum channel with reinforced corner bracing.

2. Damper blades shall be minimum 16 gauge galvanized steel or 0.080 extruded aluminum and shall not exceed 6" in width. Blades are to be suitable for high velocity performance. Provide external blade position indicators so that position can be read from the operating floor.

3. Damper bearings shall be teflon filled, nylon, or oil impregnated sintered metal.

4. All edges of the blades and top, bottom, and sides of the frame shall be provided with felt edges and wind stops. The seals shall provide a maximum of 10 CFM per square foot leakage at 4" static pressure.

5. If dampers of exact dimensions are not available, this Contractor shall be responsible for the furnishing of all blank off plates, etc.

B. Insulated Dampers.....In addition to the general specifications, the damper blades in the control building shall feature double skin construction with full length thermal insulation.

2.4 DAMPER ACTUATORS

A. General.....Damper actuators shall be drive actuated, spring return, 120 VAC, two-position type and shall include damper actuator linkage to make a complete and automatic damper.

As required by the sequence of operations, dampers shall be provided with single pole double throw, Form C, auxiliary end switches that activate at the end of powered storage. Switches shall be full load rated at a minimum of 5 amps at 120 VAC.

2.5 ELECTRIC WIRING

All control, interlock, and power wiring shall be provided and installed in accordance with the National Electrical Code. Provide diagrams and coordinate all work with the electrical contractor as required.

2.6 SEQUENCE OF OPERATION

Sequence of operation shall be as shown on the Drawings.

2.7 CONTRACTOR'S RESPONSIBILITY

Contractor shall provide all necessary contacts, transformers, relays, panels, and components for a complete and operating heating, ventilation, and air distribution control system.

PART 3 - EXECUTION

3.1 POST-INSTALLATION INSTRUCTIONS

Upon completion of the work, instruct the operating personnel in proper operation of this control system. Following completion and acceptance
of job, deliver to the Owner five (5) copies of control drawings and sequence of operation in bound form.

3.2 SERVICE AND GUARANTEE

A. After completion of the installation, adjust all thermostats, control valves, motors, and other equipment provided under this contract. Place in complete operating condition prior to requesting the approval of the Owner.

B. The control system shall be free from defects in workmanship and material under normal use and service. If within 12 months from date of acceptance by Owner any of the equipment herein described is proved to be defective in adjustment, workmanship, or material, it will be adjusted, repaired, or replaced free of charge.

End of Section
SECTION 15G - MECHANICAL, LIQUEFIED PETROLEUM GAS STORAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section of the specifications shall include all work pertaining to the LPG tank, valves, gauges, etc. associated with the fuel storage system and work incidental thereto, as shown on the Drawings and specified herein.

1.2 CONDITIONS

The conditions shall be as specified in the General Requirements and General Conditions of these Specifications and as follows:

A. The LPG system shall be in accordance with the recommendations of the NFPA Pamphlet 58, Liquified Petroleum Gases (latest issue).

B. All equipment, storage containers, and associated devices shall be Underwriters' Laboratories, Inc., listed.

C. Storage tank, vaporizer, and all appurtenances shall be in conformance with ASME Pressure Vessel Code, Section VIII, Division 1.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical, General Provisions: Section 15A.

B. Mechanical, Plumbing: Section 15B.

C. Electrical, Standby Power Generator: Section 16E.

PART 2 - PRODUCTS

2.1 LPG STORAGE TANK (PROPANE)

The storage container shall be a horizontal container type (ASME 250 psig); ASME label; 9,200 gallon water capacity; liquid fill valve with extension for loading; liquid out supply fitting and valve; excess flow check valves; safety and hydrostatic relief valves; white-painted finish; dial fuel level indicator gage; metal access housing for tank valving with locking lid; contents identification marking, "Liquefied Petroleum Gas"; "Flammable"; and all other required markings. The tank shall be manufactured by Trinity Industries, Inc., or Owner approved equal.

2.2 VALVES

A. General. . . . . Valves shall be of bronze construction suitable for use in LPG liquid systems.

B. Pressure Relief Valve. . . . . Set pressure of 250 psig.
C. Hydrostatic Relief Valve....Set pressure of 450 psig.

D. Check Valves....600 lb., cast steel, swing check, bolted cap.

PART 3 - EXECUTION

3.1 INSTALLATION

LPG storage tank shall be installed on a suitable concrete base at the location indicated, as detailed on the Drawings, as required by NFPA-58, Liquified Petroleum Gases, and as required by ASME Pressure Vessel Code, Section VIII.

3.2 INSTALLATION

A. After completion of tests, flush all piping systems and clean all equipment, piping, valves and fittings.

B. Adjust all valves and automatic control devices. Disassemble and clean if required.

End of Section
1.1 WORK INCLUDED

A. Furnish and install all materials and equipment as specified in this division and/or shown on the Drawings relating to this division.

B. The Drawings and Specifications are complementary to each other. Include any work, materials, or equipment indicated on the Drawings but not described by the Specifications, or described by the Specifications but not shown on the Drawings, which is necessary for the completion of electrical systems.

C. The Drawings show the general arrangement of circuits and outlets, location of switches, panelboards, and other work. Follow Drawings as closely as actual building construction and the work of other trades will permit. Architectural and Structural Drawings take precedence over Electrical Drawings. Because of the small scale of the Drawings, some offsets, transitions, fittings, and accessories which may be required have not been shown. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such fittings, transitions, offsets, and accessories as may be required.

D. Submission of a bid constitutes acceptance of the Drawings and Specifications as being sufficiently detailed and complete to provide for a completed, properly-functioning installation in conformance with all applicable codes, ordinances, and statutes.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The provisions of Section 1.D, General Requirements, along with all requirements and provisions of the bidding documents, including contract conditions, information or instructions for Bidders, and supplements, are part of this division. Should there be any conflict between provisions or requirements elsewhere indicated and the provisions of this division, request written clarification by addendum prior to submission of bid or abide by the interpretation of the Owner.

B. Examine all Drawings and all Specification divisions relating to the project. Include all work, materials, and equipment mentioned or shown as being provided under this division. Refer to all Contract Drawings and details in coordinating and completing work. Study all Drawings and Specifications to determine any conflicts, or omissions; accomplish work required for conformance and/or completion; and show changes on the as-built drawings. Report any discrepancies, conflicts or omissions to the Owner.

1.3 MATERIALS AND EQUIPMENT

A. Substitution of equipment or materials shall be in accordance with the General Conditions, Paragraph 6.7 and the General Requirements, Part 2.1.
B. It shall be the responsibility of the Contractor to ensure that "bidder's choice" products and alternate products conform to the Drawings and Specifications as to space requirements, performance, capacity, configuration, accessories, and materials of construction.

C. The Contractor shall be responsible for and bear the cost of all changes made necessary by the use of products other than those of the first-named manufacturer.

D. Within 15 days of Contract award, submit a list of all equipment manufacturers and subcontractors used in preparation of the bid. The equipment list shall be complete, including all subcontractors' equipment items.

E. Order equipment, and expedite delivery, to avoid delay in completion of the project. Where through no fault of the Contractor production and delivery schedules conflict with construction schedules, the Contractor shall submit a letter from the manufacturer or supplier showing the proposed delivery schedule for the item(s) in question, along with submittals for proposed substitution(s) for review by the Owner.

1.4 PERMITS, LICENSES, FEES, ASSESSMENTS, AND INSPECTIONS

A. Obtain, pay for, and maintain all required permits, licenses, and certificates of inspection.

B. Make arrangements for, and conduct, all tests and/or inspections of work required for compliance with applicable codes and ordinances and any additional testing or inspection required under the contract. The Owner shall be notified of all tests and inspections not less than 48 hours prior to the scheduled time and date.

1.5 CODES AND STANDARDS

A. Materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industrial standards, and utility company regulations. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, utility company regulations, and the Contract Documents, the most stringent shall govern.

B. Should the Contractor perform any work which does not comply with the above-described application of codes, standards, and the Contract Documents, he shall bear all costs arising from correction of the deficiencies.

C. Applicable codes and standards include the requirements and regulations of the National Fire Protection Association, insurance underwriters, all state, county, and/or municipal jurisdiction enforcing agencies, and local or jurisdictional fire prevention bureaus and/or fire marshal. The work shall further conform to the applicable requirements of the following industry standards and specifications.

   Occupational Safety and Health Act (OSHA)
   American National Standards Institute (ANSI)
1.6 SHOP DRAWINGS

A. Shop drawings shall be submitted in accordance with section 1.D, General Requirements, of these specifications and as follows. Shop drawings shall be submitted for all items listed in the "Products" sections of this division of specifications.

B. Shop drawings to include the following:

1. Manufacturer’s specifications.

2. Fabrication and erection drawings.

3. General outline drawings of equipment showing overall dimensions, location of components, weights, and locations of required building openings and floor plates.

4. Detailed equipment installation drawings showing foundation details, anchor bolt sizes and locations, wiring diagrams, location of owner’s connections, and all clearances required for erection, operation, and disassembly for maintenance.

5. Schematic diagrams for electrical items showing external connections, terminal block numbers, internal wiring diagrams, and one-line diagrams.

6. Bills of materials and spare parts lists.

7. Instruction books including operation and maintenance schedules if applicable.

8. Samples, color charts, and similar items.

C. Prior to submission, shop drawings, material lists, and catalog cuts or manufacturers’ printed data shall be thoroughly checked for compliance with Contract requirements, accuracy of dimensions, coordination with work of other trades, and conformance with sound and safe practices as to erection or installation. Each submittal shall bear Contractor’s signed statement evidencing such checking and shall show corrections proposed, if any. Revise submittals requiring extensive corrections or replace before submission. Clearly mark each submittal as follows for purposes of identification:

Submittal Number
Date
Name of Project
Branch of Work
Engineer’s Name
Contractor’s Name
Submittal Number

D. Clearly mark printed material, catalog cuts, pamphlets, or specification sheets and shop drawings as to plan code, specific item proposed, catalog numbers, recess openings, dimensions, capacities, electrical characteristics, etc. Submittals which are incomplete will be rejected.

E. Contractor agrees that shop drawing submittals processed by the Owner are not change orders; that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Owner that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the Contract Documents in the form of design Drawings and Specifications are discovered either prior to or after shop drawings submittals are processed by the Owner, the design Drawings and Specifications shall control and shall be followed.

F. Preserve two copies of reviewed submittals for delivery to the Owner upon completion and acceptance of the project, in accordance with the Specification requirements for operating and maintenance manuals.

G. Maintain one copy of submittals at the project field office until completion of the project, and make this copy available, upon request, to representatives of the Owner during visits to the project.

H. No equipment or materials shall be installed (or stored at the job site) until submittals for such equipment or materials have been given review action permitting their use.

1.7 COORDINATION

A. Before purchase or fabrication of any equipment or materials and before fabricating and/or running any raceways, determine that equipment will properly fit the space available, and that raceways can be run as contemplated without interferences between systems, with structural elements, or with the work of other trades; verify all voltages and connection requirements for equipment furnished by others and wired under this Contract. Make proper and approved provisions for access to all equipment items and specialties for servicing, adjustment, and maintenance. Submit for review when directed by the Owner, shop drawings clearly showing the interrelationship of the various portions of the work, along with its relationship to the work of other trades prior to commencing fabrication or installation of the work. Failure to properly coordinate as defined herein may result in removal and/or relocation of equipment at no additional expense to the Owner.

B. Schedule delivery of all large equipment assemblies requiring special openings for installation prior to enclosing of the areas involved.

1.8 INSTRUCTION BOOKS

A. Deliver to the Owner in accordance with and in addition to Section 1.D,
General Requirements, the following (partial or incomplete data will be rejected):

1. Nameplate Directory.....List of all equipment nameplates, giving nameplate designation, manufacturer's nameplate data, location of equipment, area served, plan identification code, switch locations, and normal position of switches.

2. Manufacturer’s Literature.....Manufacturer's instructions for operation and maintenance of all electrical equipment and specialties, including replacement parts lists and as-built wiring diagrams, on 8 1/2" x 11" sheets or catalogs, all suitable for side binding. Local representatives or service companies for each piece of equipment shall be noted, listing address and phone number.

3. Maintenance Instructions.....Typewritten instructions for maintenance of the system, including: time schedule for maintenance work, listing each item of electrical equipment requiring inspection or service, and describing the performance of such maintenance; and sequence and circuit diagrams for each of the systems, including emergency procedures, and normal starting, operating, and shutdown procedures. Instruct operating personnel in the care of the system in accordance with the approved typewritten instructions.

4. Binders.....Provide looseleaf ring binders with permanent covers, separators with index tabs, and transparent looseleaf sheet protectors for the above data.

5. Shop Drawings and Submittals.....Provide two sets of Owner's copies, in alphabetical order, in separate looseleaf binders.

PART 2 - PRODUCTS

2.1 QUALITY

All equipment and materials shall be new unless otherwise specified. Use the same brand or manufacture for each specific application of panelboards, motor starters, wiring devices, specialties, and equipment.

2.2 TYPE

The type and weight of materials used for each purpose shall be as specified in the Electrical Sections and Drawings, and all material shall conform to the requirements of the standard specification of the latest ASTM for the particular material.

2.3 IDENTIFICATION

A. All major equipment components shall have the manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.

B. Install an engraved plastic-laminate nameplate on each major unit of electrical equipment. Except as otherwise indicated provide single line of text, 1/4" high lettering on 3/4" high nameplate, white lettering on
Provide text matching terminology and numbering of the Drawings. Provide nameplate for each equipment item of the following types:

Panelboards
Motor Starters
Disconnect Switches
Transfer Switches
Control Panels

2.4 PROTECTION

A. Provide for the safety and protection of all equipment or materials until final acceptance of the project, at which time all components of all systems shall be delivered in clean and unblemished condition.

B. Prior to installation, electrical equipment shall be stored in controlled temperature environments. All enclosures containing condensation heaters shall have the condensation heaters energized.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND COMPLETION OF INSTALLATION

A. The Contractor, as well as his employees and subcontractors, shall be well-versed and skilled in the trades involved. The Contractor shall be wholly responsible for complete and proper installation of all work required for the project, including minor details not shown or specified as are necessary to complete the project.

B. Any changes or deviations from the Drawings and Specifications must be authorized in writing by the Owner before the change is made. Correct at no expense to the Owner all errors in installation, including any resulting damage to work of other trades. Install all specialties as detailed on the Drawings. Follow approved manufacturer's recommendations where details or specific installation instructions are not provided.

C. Upon completion of the work, remove all litter, waste materials, unused materials and Contractor's tools and equipment from the job site. Check, test, correctly adjust, and leave ready for proper use or operation as intended, all installed systems.

D. Close all conduit openings with caps or plugs during installation. Protect all fixtures and equipment against dirt, water, and chemical or mechanical damage. At completion, thoroughly clean and remove all residue from interior surfaces. Clean exterior surfaces of all materials and equipment and deliver in perfect, unblemished condition.

E. Complete performance tests before release of any systems to the Owner for operation. Install all safety devices and request inspection and approval of same by authority having jurisdiction before placing related systems into temporary or permanent operation.
F. Provide a complete and properly operating installation, including all labor, materials, equipment, cartage, insurance, permits, assessments, and taxes. No claims for additional compensation will be allowed except where changes are approved in writing by the Owner.

3.2 EXISTING SERVICES

A. Carefully examine all of the Drawings and Specifications, visit the site of the work, and fully check all existing conditions, dimensions, and limitations prior to starting the work. Notify all companies or agencies owning, or having jurisdiction over, existing utilities and services which interfere in any manner with the execution of the work, and remove, reroute, or protect such utilities or services as required by parties having jurisdiction over same.

B. The Drawings indicate approximate locations and routings of known utilities or service systems. If other existing active or inactive systems are encountered which require relocation or disconnection, make a written request for decision on proper resolution of any interferences.

C. Areas of existing facilities adjacent to, or part of, the area of construction will be occupied by the Owner or others during execution of the Contractor's work. Arrange the work to minimize period of interruption or outage of utilities services. Schedule necessary interruptions or outages not less than 24 hours in advance, with the time and duration of such interruptions or outages as approved by the Owner. When required, limit interruptions or outages to nonstandard working hours.

D. Report in writing to the Owner any concealed existing raceway or other material pertaining to, or affected by, the work which is not described or shown on the Drawings. Do not proceed with work affected by such concealed raceway or materials until instructed in writing as to procedure.

3.3 CUTTING AND PATCHING

A. Locate and verify all openings required in new construction for installation of the work and arrange with other trades for provision of same in the correct sizes and at proper locations. Failure to make such arrangements will cause the cost of cutting and patching to be borne by the Contractor, with all cutting and drilling to be performed by trades skilled in the work and in a manner approved by the Owner.

B. All cutting or drilling of ceilings, floors, walls, or roofs in existing construction required for the installation of raceways and electrical equipment (or removal of same) shall be accomplished by trades skilled in the work and in a manner approved by the Owner. Where existing openings are available for installation of new work, they shall be properly patched and trimmed out to produce a finished appearance for the installation.

C. Specific review and approval are required for any cutting or drilling of load-bearing members.
3.4 PAINTING

A. Thoroughly clean and prepare for painting the surface of all equipment and materials. Painting will be performed under another division of these Specifications except as otherwise indicated.

B. Where equipment, specialties, and apparatus are provided with factory finish either as the manufacturer's standard or as may be specified in this division, protect such factory finish throughout the construction period. Repair or touch up any blemishes to match original finish.

3.5 UNDERGROUND UTILITIES IDENTIFICATION

A. Install an underground tape system of utilities identification, color coded in conformity with ANSI background colors continuously imprinted with utilities identification nomenclature. Tape material and printing shall be inert and permanent nondegradable material.

B. Tape shall be 4" wide and shall be installed in trench above the identified utility line, at a depth of from 12 to 18" below finished grade or pavement subgrade level, extending continuously along the entire length of all buried utilities lines. Identification legend shall conform to the following schedule:

<table>
<thead>
<tr>
<th>Utility</th>
<th>Tape Color</th>
<th>Legend (Black Letters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>Yellow</td>
<td>Caution Electrical Service Below</td>
</tr>
</tbody>
</table>

3.6 MISCELLANEOUS EQUIPMENT WIRING AND CONNECTIONS

Provide all conduits, wire, outlets or receptacles, control devices, and disconnect switches as required for miscellaneous equipment requiring electric power or control, and make all electrical connections to provide a complete operating system. Attention is directed to other divisions of these Specifications covering the detailed requirements for these equipment items. Prior to roughing in conduit and outlets, refer to the shop drawings to ascertain the exact locations and type of final connection required.

3.7 MECHANICAL EQUIPMENT WIRING AND CONNECTIONS

A. Furnish, set in place, and wire, except as may be otherwise indicated, all heating and ventilating motors and controls in accordance with the following schedule. (Carefully coordinate with work performed under the mechanical section of these Specifications.)
<table>
<thead>
<tr>
<th>Item</th>
<th>Furnished By</th>
<th>Set In Place By</th>
<th>Wired Power</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Motors</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>*Magnetic Motor Starters:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Automatically Controlled, with or without HOA Switches</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>2) Automatically Controlled, with or without HOA Switches and which are furnished as part of factory wired equipment</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>3) Manually Controlled</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>4) Manually Controlled, and which are furnished as part of factory wired equipment</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Pushbutton Stations, Pilot Lights</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Disconnect Switches, Thermal Overload Switches, Manual Operating Switches</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>Contactors</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Wall Mounted Electric Thermostats, Humidistats</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Air Flow Switches, Remote Bulb Thermostats, etc.</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>M</td>
</tr>
<tr>
<td>Damper Motors, Etc.</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>Electric Heating Elements, Staging Contactors, Etc.</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
<tr>
<td>Temperature Control Panel</td>
<td>M</td>
<td>M</td>
<td>E</td>
<td>M</td>
</tr>
</tbody>
</table>

M - Mechanical Division
E - Electrical Division

*Starters which are to be furnished under the Mechanical Division shall be in accordance with the Electrical Division of these specifications.
B. Complete wiring diagrams for equipment and systems specified in Division 15 for installation purposes shall be furnished under the Mechanical Division. All line and low voltage wiring shall be installed utilizing materials and methods as specified in this section of the specifications.

C. NEMA rated motors and equipment shall be utilized for operation on the voltage systems as designated below with tolerances for the allowable voltage variations above and below the nominal.

<table>
<thead>
<tr>
<th>Service Voltage and Phase</th>
<th>Rated Motor Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>277/480, 3Ø</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>480</td>
</tr>
</tbody>
</table>

D. Verify the available voltage and phase characteristics for each motor before connecting any motors. All motors shall be provided having voltage and phase characteristics and indicated on the electrical drawings. The above table shall be used as a guide only.

3.8 FINAL ADJUSTMENTS

A. Check equipment for proper operation and complete final adjustments prior to performance tests and prior to final observation and acceptance of the project.

B. After final acceptance, make, upon request, such further adjustments as necessary to obtain satisfactory performance of systems.

3.9 TESTS

Upon completion of the work, at a time to be designated by the Owner, the Contractor shall demonstrate for the Owner the operation of the entire electrical installation, including any and all special systems provided under this Contract.

End of Section
SECTION 16B - ELECTRICAL, BASIC MATERIAL AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

This section of the Specifications shall consist of performing all labor and furnishing all material, fixtures, and equipment necessary for a complete and operating electrical system.

1.2 CONDITIONS

The conditions shall be as specified in Section 16A of this set of Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical, General Requirements: Section 16A.
B. Service and Distribution: Section 16C.
C. Lighting: Section 16D.
D. On Site Power Generation: Section 16E.
E. Instrumentation and Control Systems: Section 16F.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Duplex receptacles shall be rated 20 ampere, 125 volt, 2 pole, 3 wire, grounding type as manufactured by General Electric (GE 4014-2), Pass and Seymour, Hubbell, or equivalent. The color shall be ivory.

B. Weatherproof receptacles shall consist of duplex receptacle mounted in a box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. Cover plate shall be Killark series FS or FD, or an Owner approved equal. All receptacles shall be weatherproof.

2.2 SWITCHES

All switches shall be of the totally enclosed tumbler type, completely in stable composition or ceramic housing. Terminal screws or connectors shall be designed to accommodate and firmly terminate up to No. 10 solid conductors. The color shall be ivory.

A. Wall switches controlling 120 volt or 277 volt lighting loads shall be rated not less than 20 amperes. Wall switches controlling motor loads shall be horsepower rated for the load controlled and shall not be rated less than 20 amperes. Switches shall be as manufactured by General Electric (GE 5921-2), Pass and Seymour, Hubbell, or Owner approved equal.
B. Three-way switches controlling 120 volt or 277 volt lighting loads shall be rated not less than 20 amperes. Switches shall be as manufactured by General Electric (GE 5923-2), Pass and Seymour, Hubbell, or Owner approved equal.

C. Four-way switches controlling 120 volt or 277 volt lighting loads shall be rated not less than 20 amperes. Switches shall be as manufactured by General Electric (GE 5924-2), Pass and Seymour, Hubbell, or Owner approved equal.

D. Weatherproof switches shall consist of the required type switch mounted in a box with a gasketed, weatherproof, cast aluminum cover plate and cap over each switch opening. Cover plate shall be Killark type FZ or an Owner approved equal. All switches shall be weatherproof.

E. All screws used for mounting of weatherproof devices (switches and receptacles) shall be stainless steel.

2.3 CONDUIT

A. Galvanized-rigid-conduit (GRC) for general use shall be sized as required by the NEC with the minimum size being 3/4-inch.

B. PVC conduit shall be schedule 40 or schedule 80 as called for on the Drawings. U.L. listed for 90°C conductors. Conduit shall be Schedule 80 if not called out on the Drawings.

C. Flexible metal conduit for general use shall be galvanized steel, with steel fittings, and shall be seal tight liquidtight conduit.

2.4 CONDUCTORS

A. Provide factory-fabricated wire of sizes, ratings, materials, and types indicated for each service. Where not indicated, provide proper selection as determined by Contractor to comply with project’s installation requirements, NEC standards, and U.L. requirements for termination of wire to circuit breakers; e.g. circuit conductors connected to the terminals must not operate at more than a 60°C ampacity for breakers 100 amps or less and must not operate at more than a 75°C ampacity for breakers rated over 100 amps. Select from the following types, materials, conductor configurations, insulation, and coverings:

UL Type: THHN, THWN.
Minimum Size: #12 AWG.
Material: Copper.

1. Conductors.....Solid (AWG #12 to AWG #8, light and power circuits only). Concentric-leaf-stranded (standard flexibility).

2. Outer Covering.....Thermoplastic.

3. All conductors used for control and indication circuits shall be stranded copper.

4. All wiring for control shall be color coded in accordance with the wir-
ing diagrams furnished with the equipment. All branch circuit wiring including circuits to motors and all feeders shall be coded by line or phase as follows:

Wire No. 2 and smaller shall be factory color coded. Wire No. 1 and larger may be color coded by field painting or color taping of 6" length of exposed ends.

<table>
<thead>
<tr>
<th>120/208 Volts</th>
<th>277/480 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Black</td>
<td>A - Brown</td>
</tr>
<tr>
<td>B - Red</td>
<td>B - Orange</td>
</tr>
<tr>
<td>C - Blue</td>
<td>C - Yellow</td>
</tr>
<tr>
<td>Neutral - White</td>
<td>Neutral - Gray</td>
</tr>
<tr>
<td>Ground - Green</td>
<td>Ground - Green</td>
</tr>
</tbody>
</table>

B. Conductors for transmission of 4-20 mA signals shall be silver plated concentrically stranded copper twisted pairs shielded with braided silver plated copper shield covered with Teflon coating, sized to prevent excessive voltage drop in the current loops, with No. 18 being the minimum size.

C. Wire markers shall be rigid PVC material, clip-on type "C" markers, or Owner approved equal.

D. Wire pulling lubricant shall be Ideal "yellow", Dow Corning Compound #4, or Owner approved equal.

E. Multiconductor control cable shall consist of color coded, individually insulated, copper conductors with a polyester-film tape over the conductor and an overall GEOPRENE jacket as manufactured by GE or an Owner approved equal. The number and size of the individual conductors shall be as indicated on the drawings.

2.5 SUPPORT SYSTEMS

Provide supporting devices complying with manufacturer's standard design and construction in accordance with published product information and as required for a complete installation. All conduit clamps, conduit straps, bolts, nuts, and all-thread rods shall be stainless steel.

U-channel strut systems for supporting electrical equipment shall be steel with phosphated and electrodeposited finish for high rust resistance, with standard green finish, and with the following stainless steel fittings which mate and match with U-channel:

- Fixture hangers
- Channel hangers
- End caps
- Beam clamps
- Wiring stud
- Rigid conduit clamps
2.6 OUTLET BOXES

A. All boxes shall be of sufficient size to accommodate the number of conductors entering the box in addition to the devices installed in the box, per the National Electrical Code.

B. Metal boxes shall be cast aluminum with treaded hubs and mounting lugs where required.

2.7 MOTORS

Motors are specified in the sections with the equipment to which they pertain.

2.8 JUNCTION BOXES

Exterior junction boxes shall be as detailed on the drawings.

2.9 SEAL OFFS

Seal offs shall be the full conduit size and shall be as manufactured by Killark ENY series or Owner approved equal.

2.10 FUSED DISCONNECT SWITCHES

Fused disconnect switches shall be heavy-duty, 3-pole, 4-wire, solid neutral single throw fusible type rated at 600 volts. The switches shall be sized as shown on the drawings.

Switch mechanism shall be the quick-make, quick-break type and shall be capable of closing into a fault. Lugs shall be UL listed for copper cables and shall be front removeable. Switches installed in services utilizing paralleled phase conductors shall have lugs capable of terminating paralleled conductors.

Switch enclosure shall be NEMA type 12. The enclosure shall employ a hinged cover, for access to the fuses, which shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position. This interlock shall be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service.

The units shall have padlocking provisions in the "ON" or "OFF" position, and the operating handle position shall give positive switch position indication.

Each fused disconnect shall be installed with dual element fustron fuses. Fuses shall be sized as indicated on the drawings.

All fuses shall be vertically mounted to assure optimum performance and minimum contamination. All fuses shall be easily inspected or replaced.
without switch disassembly.

The Contractor shall furnish a spare set of fuses for each fused disconnect switch.

Each fused disconnect shall have a minimum interrupting capacity of 12,000 symmetrical RMS amperes.

Fuses disconnect switches shall be as manufactured by General Electric, Square D, or an Owner approved equal.

2.11 NON-FUSED DISCONNECT SWITCHES

Disconnect switches shall be heavy-duty, 3-pole, solid neutral, single throw type rated at 600 volts. Switches shall be sized as shown on the drawings.

Switch mechanism shall be the quick-make, quick-break type. Lugs shall be UL listed for copper cables and shall be front removable.

Switch enclosures shall be NEMA type 12. The enclosure shall employ a hinged cover which shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position. This interlock shall be constructed so that it can be released with a standard electrician's tool.

The units shall have padlocking provisions in the "ON" or "OFF" position, and the operating handle position shall give positive switch position indication.

Disconnect switches shall be as manufactured by General Electric, Square D, or an Owner approved equal.

2.12 LIGHTNING PROTECTION

A. Air terminals shall be in accordance with UL 96 and NFPA No. 78, Class I, and shall be tapered to a point. The tip of the terminals shall be a minimum of 10" above the roof. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints. Locations shall be as indicated on the Drawings.

B. Roof conductors shall be in accordance with NFPA No. 78 and UL 96 for Class I. Conductors shall be copper and shall not weigh less than 190 pounds per thousand feet. Sharp bends or turns shall be avoided with minimum radius of 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof. Roof conductors shall be connected to form a closed loop.

C. Down conductors shall be in accordance with NFPA No. 78 and UL 96 for Class I. Conductors shall be copper and shall not weigh less than 190 pounds per thousand feet. Down conductors shall be electrically continuous from air terminals and roof conductors to ground plates. Conductors shall be fastened to the exterior wall every 3 feet and shall be protected, where necessary, to prevent mechanical injury to the
conductor.

D. Terminal bases shall be for flat masonry surfaces. Bases shall be pressed copper with cable connection and screws and anchors.

E. Ground plates shall be 20 gauge sheet copper with cable connections. Minimum size shall be 18"x18".

F. The Contractor shall conduct an air terminal-to-ground resistance test. The resistance to ground at any terminal shall not exceed 10 ohms. If the resistance values exceed 10 ohms, the system shall be checked for loose or broken connections or cables, or for corrosion. If correcting all connection and corrosion problems does not reduce the system resistance values to below 10 ohms then the resistance to ground of the down conductors shall be tested. If the resistance to ground values of the down conductors exceeds 10 ohms then additional ground plates or ground rods shall be installed and bonded to the lightning protection system. Maintain a minimum separation of 10 feet between the ground rods or ground plates. All resistance-to-ground measurements shall be prepared in tabular form and submitted with cross reference made to air terminals identified on the as-built drawings.

PART 3 - EXECUTION

3.1 RECEPTACLES

Receptacles shall be installed at locations shown on Drawings and mounted at the height indicated.

3.2 SWITCHES

Switches shall be installed at the locations shown on the Drawings. Where more than one switch is shown at one outlet, they shall be installed under one plate in an order appropriate to the location of the outlets controlled.

3.3 CONDUIT

Exposed conduits shall be run parallel to or at right angles with lines of the building. All bends shall be made with standard conduit ells or conduit bent to not less than the same radius of screw jointed conduit fittings. All bends shall be free from dents or flattening. Not more than the equivalent of four-quarter bends shall be used in any runs between terminals at cabinets, outlets, and junction to all boxes. All boxes shall be located in accessible locations.

Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction, or pull boxes; and they shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Terminals of all conduits shall be furnished with locknuts and bushings. The Contractor shall plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign materials when exposed during construction.
Couplings and conduit unions shall be of the same material as the raceway. They shall have the conventional dimensions of the trade and shall be internally threaded with a tapered thread at each end to fit the tapered thread specified for the corresponding size conduit.

All outlet boxes shall be of the same material as the conduit to which they are connected, and they shall be of the type and size required for each particular use. Fittings not specifically called for on the Drawings but required to complete conduit runs shall be installed subject to the approval of and at no additional cost to the Owner.

The inside and outside of all rigid steel conduit and fittings including bolts and screws shall be protected against corrosion by an even coating of zinc applied by the hot-dip process. Before galvanizing all surfaces shall be cleaned. The cleaning process shall leave the surface in such a condition that the zinc coating will be firmly adherent and will be smooth.

Where conduit has to be cut in the field, it shall be cut square, using a hand or power hacksaw or approved pipe cutter using knives. The use of pipe cutters with cutter wheels will not be permitted. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit. Conduits installed in the work with threads not complying with these requirements shall be removed and replaced.

All conduit shall be cleaned prior to pulling in wire and cable, by pulling a stiff wire brush of the size of the conduit through it. The cleaning shall remove all foreign matter, including water from the conduit. All boxes in which the conduit terminates shall be cleaned of all concrete, mortar, or other foreign matter, and all threads in boxes shall be left clean and true upon completion of the work.

Exposed conduit runs shall be supported or clamped to walls at spacing not exceeding 8-foot intervals.

Exposed conduit shall be galvanized rigid conduit.

All conduit passing through or cast into concrete slabs or poured walls shall be galvanized rigid conduit.

All conduit run under the slab or underground shall be PVC schedule 40 unless indicated otherwise on the Drawings. PVC to GRC transitions shall be made before penetrating poured wall or slab.

Flexible, sealtight conduit shall be used for connection to vibrating equipment, i.e. motors, valve operators, etc. The flexible conduit connection may be used as the equipment ground connection in accordance with Article 250-5 of the National Electrical Code.

All conduit installations and methods shall comply with the local, state, and national electrical codes.
Installation of all conduit needed for homerun signals from field instrumentation shall be the responsibility of the electrical contractor.

3.4 SUPPORT SYSTEM
-----------------
Install hangers, anchors, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC, and ANSI/NEMA for installation of supporting devices.

Fabricate U-channel support systems for equipment mounting as indicated on the Drawings.

Ends of U-channel cut in the field shall be painted to prevent corrosion.

Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

Install hangers, supports, clamps, and attachments to support piping properly from building structure.

3.5 WIRING METHODS
--------------
A. Conductor insulation type shall be as specified in Section 16B.2.5 of these Specifications.

B. Cutting and drilling of structural members shall be limited to that essential to proper installation. Holes in joists or studs for cable type wiring shall be protected from nails or screws by a steel plate of appropriate length and width, per National Electrical Code requirements. The Contractor shall obtain permission of the Owner before cutting or drilling any structural member.

C. All terminating fittings, connections, etc. shall be of a type suitable for the specific cable furnished. All fittings shall be made up tight. Make up all termination in strict accordance with manufacturer's recommendations using special washers, nuts, etc. as required.

D. Splices and connections shall be made as follows:
   1. Connect No. 8 AWG and larger wire to panels and apparatus with properly sized, solderless or compression lug connectors.
   2. Connect No. 10 AWG and smaller wire by applying properly insulated wire nuts or pressure connectors.
   3. Flashover or insulation values of joints shall equal that of the conductors. Connectors shall be rated at 600 volts for general use and 1000 volts for use within fixtures.

E. Wire markers shall be installed on all wiring used for 4-20 mA DC signal,
120 VAC status or control, and all low voltage control wiring. Tabulation of all wires so marked, with a description of where they are used, shall be included with the "AS-CONSTRUCTED" drawings.

3.6 BOXES

A. Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. All outlet boxes and exposed non-current-carrying metallic parts of electrical equipment shall be connected to the grounding bar provided in the light panels. An equipment ground wire shall be included in branch circuit raceways which contain sections of PVC conduit.

C. All conduits and outlet boxes shall be securely anchored and the complete installation made in a mechanically and electrically sound manner.

D. The exact location of outlets and equipment shall be governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or other devices are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc. with the Owner. Outlet boxes in walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Provide barrier partitions between adjacent switches located in the same box when voltage between switches exceeds 300 volts. Sectional switch boxes or utility boxes will not be permitted.

3.7 MOTORS

Sealtight flexible metal conduit shall be used to run power from all motors to junction boxes unless otherwise indicated.

3.8 JUNCTION BOXES

Exterior junction boxes shall be located as shown and detailed on the drawings.

3.9 FUSED DISCONNECT SWITCHES

The fused disconnect switches shall be located as indicated on the drawings.

3.10 DISCONNECT SWITCHES

Disconnect switches shall be located as indicated on the drawings.
3.11 TESTS

After the interior-wiring system installation is completed, and at such time as the Owner may direct, the Contractor shall conduct an operating test for approval of the Owner. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Owner.

End of Section
SECTION 16C - ELECTRICAL, SERVICE AND DISTRIBUTION
-----------------------------------------------------------------------------------------------------------------
PART 1 - GENERAL
-----------------------------------------------------------------------------------------------------------------
1.1 DESCRIPTION
--------
This section of the Specifications shall consist of performing all labor and furnishing all materials and equipment necessary for a complete and operating electrical service entrance and distribution system.

1.2 CONDITIONS
--------
The conditions shall be as specified in Section 16A of these Specifications.

1.3 COORDINATION
--------
The Contractor shall coordinate all work with the local electrical utility.

1.4 RELATED WORK SPECIFIED ELSEWHERE
---------------------------------------------
A. Electrical, General Requirements: Section 16A.
B. Basic Materials and Methods: Section 16B.
C. Lighting: Section 16D.
D. On Site Power Generation: Section 16E.
E. Instrumentation and Control: Section 16F.

1.5 PRIMARY ELECTRICAL SERVICE
---------------------------------------------
The primary electrical service shall be furnished by the local power company and will be terminated at the delivery pole at the primary voltage of 12.5 KV. The delivery pole and all downstream equipment shall be provided by the Contractor, as detailed on the Drawings.

The Contractor shall coordinate the construction with the local power company. The primary power extension fees owed to the power company shall be paid by the Owner.

1.6 SECONDARY ELECTRICAL SERVICE
---------------------------------------------
A. The secondary electrical service shall be 277/480 volt, three (3) phase, four (4) wire, for main power and will be derived from a pad mounted transformer.

B. Install the conduit and conductor service from the pad mounted transformer to the main switch gear. Install the type connections required by the local power company for the transformer secondary terminals.

C. 208/120 volt, three-phase, four-wire service shall be derived from
dry-type transformers as indicated on the Drawings.

1.7 METERING FACILITIES

A. The Contractor shall furnish one (1) thirteen terminal KWH meter base and one (1) thirteen terminal KVAR meter base. The Contractor shall coordinate types of bases with the local power company.

B. The local power company will furnish and install the KWH and KVAR meters. The local power company will furnish and install conductors, current transformers, and potential transformers and make all connections between these transformers and meters.

C. Contractor shall furnish 1" PVC from the metering transformers to the meter sockets.

PART 2 - PRODUCTS

2.1 METER SOCKETS

Meter sockets shall be instrument transformer rated 13 terminal sockets for use with a test switch. Meter socket test switch enclosure shall have a two-piece front. Meter socket terminals shall accommodate #14 through #4 wire and shall be as manufactured by Milbank (574490) or an Owner approved equal.

2.2 GROUNDING

Ground rods shall be copper-clad steel, minimum 1" X 10'.

2.3 MOTOR STARTERS

All starters shall be designed and tested to meet all applicable NEMA, IEEE, and ANSI published industrial standards. All starters shall be full voltage, across the line, circuit breaker type AC combination starters and shall be nonreversing.

Circuit breakers shall be motor circuit protector type with adjustable magnetic trip settings.

All starters shall be for use on a 480 volt, three phase, 60 hertz system and shall be of the size indicated on the Drawings. All motor starters shall be supplied complete with single phase, phase reversal, and low voltage protection. Contractor coils shall be rated for 120 volt operation derived from an integral control transformer.

All combination starters shall have a minimum interrupting capacity of 22,000 symmetrical RMS amperes. The motor starters shall be designed as a coordinated circuit breaker, contactor, and overload system.

Overload relays shall be an integral part of the starters. Overload relays shall have a +15 percent adjustment. A continuous selection of motor full load currents can be obtained through the size limitations of the starters. Overload relays shall be field convertible from manual
reset to automatic reset.

The starter shall be inoperative unless thermal units are installed.

Starters shall be supplied complete with all special equipment as called for on the Drawings.

Combination starters shall be housed in NEMA 12 enclosures.

Included with each starter shall be:

A. A Micarta nameplate with white cut letters of suitable size to designate the purpose of the circuit. The nameplate shall be fastened to the unit with screws.

B. A permanently mounted illustrated operating and safety instruction card, including abridged renewal parts data.

C. An insulated fuse puller for control fuses.

D. An easy to read pictorial installation leaflet complete with step-by-step installation procedures.

2.4 BRANCH CIRCUIT PANELBOARD

A. Panelboard shall be of voltage, phase, and capacity indicated on the Drawings and shall be equipped with molded case, bolt-on circuit breakers, of the sizes shown in the panel schedules on the Drawings. Circuit breakers serving motor loads shall be equipped with means for padlocking in the open position. Circuit breakers serving HID lighting loads shall be designed for that purpose.

B. Circuit breakers shall be quick-make, quick-break, thermal-magnetic, trip indicating and have common trip on all multipole breakers. Provisions for additional breakers shall be such that field addition of connector or mounting hardware will not be required to add breakers to the panelboards.

C. All panelboards shall be equipped with a solid neutral assembly, an equipment grounding bar and shall contain copper bus bars throughout.

D. Panelboard shall be suitable for the mounting indicated on the Drawings. Enclosures shall be NEMA Type 12.

E. Circuit directory frame and card with a clear plastic cover shall be provided on the inside of the door. The directory shall be typed to identify the load fed by each circuit.

F. All panelboards shall have 10,000 amps interrupting capacity.

G. The panelboards shall be as manufactured by Square D Company, Westinghouse, General Electric or an Owner approved equal.
2.5 VENTILATED DRY-TYPE TRANSFORMER

A. Dry-type transformers shall be three-phase, 60 hertz, air-cooled type mounted in suitable ventilated enclosures.

B. Primary voltage shall be 480 volt, three-phase, three-wire; secondary voltage shall be 120/208 volts three-phase, four-wire.

C. Transformers shall have two 2-1/2% taps above and below normal.

D. Temperature rise shall not exceed 150°C under full load in a maximum ambient of 40°C. Transformer shall be capable of carrying 20% continuous overload, without exceeding the insulation rating. The temperature rise shall be designated on the transformer nameplate.

E. All transformers shall be built in accordance with the latest revised standard of AIEEE, ASA, and NEMA standards.

F. The enclosure shall be constructed of heavy gauge sheet steel. All ventilating openings shall be in accordance with NEMA and National Electrical Code Standards for ventilated enclosures. All transformer enclosures shall be weatherproof.

G. Terminals must be located in an area of the enclosure where the temperature does not exceed 60°C overall to avoid restrictions on cable insulation and avoid the need for special instructions to the installer. Terminals should be of such a size as to accommodate cable sizes compatible with NEC current carrying capacities.

2.6 AUTOMATIC TRANSFER SWITCHES

A. General....The automatic transfer switches shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The automatic transfer switches shall be mechanically held and electrically operated by a single-solenoid mechanism energized from the source to which the load is to be transferred. The switches shall be rated for continuous duty and be inherently double throw. The switches shall be mechanically interlocked to ensure only one of two possible positions – normal or emergency. The automatic transfer switches shall be suitable for use with emergency sources such as an engine driven generator source.

All main contacts shall be the silver alloy wiping action type. The operating transfer time in either direction shall not exceed one-sixth (1/6) of a second.

All replaceable contacts, coils, springs and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

Control module sensing and control logic shall be Solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers and shall have a minimum contact rating of ten (10) amperes.
Automatic transfer switches utilizing components of molded-case circuit breakers, contactors, or parts thereof which have not been intended for continuous duty or repetitive load transfer switching are not acceptable.

Automatic transfer switch shall be rated 400 amperes, 480 VAC, 3 phase, 4 wire.

The automatic transfer switches shall conform to the requirements of NEMA Standard ICS 2-447 and Underwriters' Laboratories UL-100S and shall be UL limited as follows:

For use in emergency systems in accordance with Articles 517 and 700 of the National Electrical Code.

Rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten filament lamp loads as referred to in Paragraph 30.9 of UL-100S.

The automatic transfer switches shall be open type mounted in the sections of the main switch gear shown on the drawings.

Automatic transfer switch shall be three-pole with overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which transfer is being made. The overlapping neutral transfer contacts shall not overlap for a time duration greater than 100 milli-seconds. A nonoverlapping neutral transfer (fourth) pole shall not be acceptable. Switches and accessory devices shall be ASCO 940 or Owner approved equal.

B. Tests.....Certified independent laboratory test data on a switch of the same design and rating shall be provided to confirm the following switching abilities.

Overload and endurance at 480 volts AC per tables 21.2 and 23.2 of U.S.-100S when enclosed according to section 1 above.

Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits of the insulation in contact with current-carrying parts.

Withstand current tests per Paragraph 25 of UL-100S.

Dielectric test at 1960 volts minimum after the withstand current test.

No welding of contacts. Transfer switch must be able to operate by the normal means after the withstand current test.

All production units should be subjected to the following factory tests:

The complete automatic transfer switch should be tested to ensure proper operation of the individual components and correct overall sequence of
The automatic transfer switch control panel shall utilize solid-state sensing on normal and emergency for automatic, positive operation.

All phases of the normal source voltage shall be monitored line-to-line. Close differential voltage sensing shall be provided. The pickup voltage shall be adjustable from 85% to 100% of nominal, and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency shall be initiated upon reduction of normal source to 85% of nominal voltage, and retransfer to normal shall occur when normal source restores to 95% of nominal.

Sensing relays shall operate without contact chatter or false response when voltage is slowly varied to dropout and pickup levels. Four auxiliary contacts shall be provided: two for switch position indicating use, mounted on same shaft with main contacts; two auxiliary contacts, one normally open and one normally closed, shall operate after the override delay. All auxiliary contacts shall have ten ampere minimum continuous contact rating. A test switch shall be on the door or trim of all enclosed switches. Terminals shall be provided when remotely located test switches are specified.

Phase relays shall be provided for full phase failure protection. These relays shall be 65% to 70% dropout, 92% to 95% pickup type.

D. Accessories......One second (nominal) fixed time delay to override momentary normal source outages and delay all transfer switch operating signals. Retransfer to normal time delay, adjustable 2 to 25 minutes in one minute increments and a five minute fixed unloaded running time delay for emergency generator cooldown. Time delays are automatically bypassed if emergency source fails.

Test switch to momentarily simulate normal source failure.

Engine control contact closes when normal source fails. Gold plated for low voltage engine starting signals or other customer use. Rated 25 amps, 36 volts DC.

Signal light, white, indicates when automatic transfer switch is connected to normal source.
Signal light, amber, indicates when automatic transfer switch is connected to emergency source.

Two auxiliary contacts closed when automatic transfer switch is connected to normal. 10 amps, 480 volts, 60 Hz, general use.

Two auxiliary contacts closed when automatic transfer switch is connected to emergency. 10 amps, 480 volts, 60 Hz, general use.

Selector relay functions as close differential voltage relay and transfer control relay. Measures normal source voltage. Set to drop out at 83% to 85%, and pick up at 92% to 95%.

Lockout relay is voltage and frequency sensitive and senses the emergency source.

Phase under voltage relays factory set at 90% pickup, 70% dropout.

Impphase monitor controls for transfer and retransfer of motor loads, so that inrush currents do not exceed normal starting currents.

Harnessing between transfer switch and control panel shall have built-in disconnect for routine maintenance.

E. Certification....Upon request, the manufacturer shall provide a notarized certifying compliance with all the requirements of this specification. The certification shall identify, by serial number (2), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of submittals, shall be included in the certification.

2.7 CROSSARMS

Climbing space, wire clearances, and vertical and longitudinal strength of crossarms shall conform to the National Electrical Safety Code. Crossarms shall be straight and free of twists to within 1/10 inch per foot of length. Bend or twist shall be in one direction only. Crossarms shall be machined, chamfered, trimmed, and bored for all pins and bolts required before pressure treatment. The cross-sectional dimensions of the crossarms shall be not less than 3-3/4" x 4-3/4". The overall length of crossarms shall be not less than 8'-0".

Crossarms shall be bolted to poles with 5/8-inch through bolts with square washers at each end. Bolts shall extend not less than 1/8 inch nor more than 2 inches beyond the nut.

2.8 CROSSARM BRACES

Flat braces shall be provided on all crossarms and shall be zinc-coated structural steel. Braces shall be 1/4"x1-1/4", not less than 28 inches long. Braces shall be bolted to arms with 3/8" carriage bolts with round washer between bolthead and crossarm, and secured to poles with 1/2"x5" drivepoint lag screws after crossarms are leveled and aligned.
2.9 POLES

Poles shall be full length pressure-treated southern pine or douglas fir. Pole shall be Class 4 and 45 feet in length. All clearance specified by the National Electrical Safety Code shall be maintained. Poles shall be turned smooth full length, and shall be roofed, gained, and bored prior to pressure treatment.

2.10 SURGE ARRESTERS

Zinc-oxide type, intermediate class lightning arresters suitable for outdoor installations shall be provided at locations shown on the Drawings. Selection of arrester ratings and classification according to use shall be as described by NEMA. Arresters shall be equipped with suitable mounting brackets for the applicable method of mounting. Arresters shall be grounded and may be combined with fuse cutouts.

2.11 PRIMARY-FUSE CUTOUTS

Fuse cutouts shall be normal duty, open type rated 15 KV nominal dropout type with fuse link. Fuse links shall be rated 25E for service to 300 KVA transformer. A combination arrester/fuse cutout may be used.

2.12 INSULATORS

Insulators for use on the primary distribution system shall conform to the applicable USA STANDARDS for the installation. Suspension type insulators shall be used at deadends. All insulators shall be suitable for the voltage, mechanical strength, and installation required.

2.13 UNDERGROUND CONDUCTORS

Provide shielded copper conductors rated for 15 KV. Conductors shall be #2 AWG with cross-linked polyethylene insulation, bare copper concentric wire shield and jacket for grounded neutral system.

2.14 OVERHEAD LINE CONDUCTORS

Line conductors for primary service shall be 2 AWG bare hard-drawn aluminum cables steel reinforced. Conductors shall be stranded. Splices under tension shall be mechanically and electrically secure with a strength not less than the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect the conductor with which they are used. Conductors shall be tied to insulators in an approved manner. Tie wires for conductors shall be No. 2 AWG strong copper alloy. Conductors shall be armored at all supports with approved armor recommended by the manufacturer. Conductors shall be properly protected with armor, armor rods, or preformed armor rods at all supports to prevent damage to the conductors. The installation of conductors shall be in strict conformance with the recommendations of the manufacturer. When hot line clamps and split-bolt connectors are required on conductors, they shall be installed over armor, armor rods, or preformed tap armor rods as applicable in accordance with standard practices, and stirrups will not be required. All dead-ends shall be made with approved clamps designed.
for the purpose, with a strength not less than the conductor. Care shall be taken in handling and stringing of conductors to guard against cuts, scratches, and kinks. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When drawn by machine power, conductors shall be drawn from the mounted reel through approved stringing sheaves in approximately straight lines and clear of all obstructions.

2.15 POLE-LINE HARDWARE

Hardware shall be hot-dip galvanized. Suitable washers shall be installed under bolt heads and nuts on wood surfaces. Washers used on throughbolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolts on which the washers are used. Washers for use under the heads of carriage bolts shall be of proper size to fit over the square shank of the bolt. Eyebolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to adequately support and protect the poles, crossarms, guy wires, and insulators.

2.16 STRESS CONES

Provide 15 KV pre-formed stress cones complete with ground strap, mold bodies and mounting brackets suitable for exposed (outdoor) use. Electrical resin shall force all air from between the cable insulation and the insulator housing and shall make a moisture proof seal around the cable. Stress cones shall be as manufactured by 3M Company, Scotchcast Brand type 83A3 or approved equal.

2.17 RECLOSURES

An automatic circuit reclosure shall be provided to allow temporary faults to clear without prolonged outages. The reclosure shall sense overcurrents, time and interrupt fault currents, and reclose automatically. The reclosure shall lock open after three operations on a permanent fault. Reclosure shall be three phase, hydraulic control, oil interrupters. Reclosure shall have a nominal voltage of 2.4 to 14.4 KV and be sized for a continuous current of 13.9 amps.

2.18 ISOLATION/BYPASS SWITCH

A gang operated isolation and bypass switch shall be installed to bypass and isolate the reclosure for maintenance or replacement. The switch shall be rated 14.4 KV and shall have a SM-5 30E fuse. A station prong for removal and replacement of fuses and a switch operator for operation from the ground shall be provided. Switch operator shall be tamperproof and padlockable.

2.19 GUYING

Provide a guy for the dip pole with a minimum rod diameter of 3/4 inches and a minimum rod length of 8 feet. Anchor rod shall use a rock anchor for fractured bedrock and shall have a thimble eye for the guy. Guying shall include clamp at thimble eye, guy marker, guy strain insulator,
clamp at pole connection and other necessary hardware. Guy wire shall be utilities grade, zinc-coated, steel strand with a minimum breaking strength of 13,000 pounds.

2.20 TRANSFORMER STATION

Transformer station shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations for use on primary systems shall be 15 kV between phases for 133 percent insulation level. The voltage rating of protective devices for use on primary or secondary systems shall not be less than the nominal voltage of the system to which they are connected. Transformer station shall be provided with integral intermediate class surge arrester protection. Insulating fluids containing tetrachloroethylene (perchloroethylene) or polychlorinated biphenyl (PCB's) are not acceptable.

A. Pad-Mounted Tamperproof Compartmental Transformer Station

Pad-mounted tamperproof compartmental transformer station shall be of the loop feed type with one set of high-voltage bushings used for cable feed and the other set of high-voltage bushings available for surge protection devices. Protective devices shall have ratings compatible with the associated transformer rating. Transformer station shall be assembled and coordinated by one manufacturer and transformer station shall be shipped as a complete unit. Transformer station shall be given a rust-inhibiting treatment and a standard finish coat by the manufacturer. Barriers are required between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be a fully insulated bushing with a removable ground strap connected between the neutral and the ground pad.

B. High-Voltage Compartment

High-voltage compartment shall be dead-front construction. Primary protection shall include load-break switching, drawout dry-well-mounted current-limiting 25E slow fuses, and medium-voltage separable connectors. Switches shall be of the group-operated type. Switches may be mounted inside transformer tanks with switch operating handles located in high-voltage compartments and equipped with metal loops for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the OFF position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "Do not open separable connectors unless switch is off". Adjacent switches, nameplates shall identify switch operating handles and ON and OFF positions. Fuses must have a 25,000 ampere interrupting current rating.

C. Surge Protection

Protection for radial feed applications shall consist of combined dead-front molded-rubber separable connectors and intermediate class zinc-oxide gapless varistor surge arrestors connected to one side of a loop feed bushing pair. Combination units shall meet the applicable requirements of IEEE No. 386 and NEMA LA 1. Voltage ratings shall be 15kV.
D. Transformer Tank Sections. Transformers shall be three-phase wye-wye, oil-immersed units with two separate windings per phase. Core construction shall be 5-legged type. Capacities and ratings shall be as shown. Four 2-1/2 percent rated kVA high-voltage taps shall be provided above and two below rated primary voltage. Operating handles for primary tap changers shall be located within high-voltage compartments, externally to transformer tanks. Transformer impedance shall be in accordance with industry standards.

E. Low-Voltage Compartment. Low-voltage compartment shall be dead-front construction. Neutral shall be provided with fully-insulated bushing. No ground strap shall be provided between neutral and ground pad. Clamp type cable terminations, suitable for both copper and aluminum conductors entering from below, shall be provided as necessary.

F. Accessories. Instruction nameplates shall include the number of gallons of transformer oil. High-voltage warning signs shall be permanently attached to each side of transformer station. Stainless steel ground connection pads shall be provided in both the high- and low-voltage compartment. Dial-type thermometer, liquid-level gage, and drain valve with built-in sampling device shall be provided for each transformer station.

G. Installation. Transformer station shall be mounted on a concrete pad. Unit shall be carefully installed so as not to scratch finishes. After installation, finished surfaces shall be inspected and scratches touched up with a finish furnished by the manufacturer especially for this purpose.

Transformer shall be mounted on a concrete mat extending approximately 10 inches beyond transformer on all sides. The mat must be at least 6 inches thick, with chamfered top edges, reinforced with woven wire mesh, and have a well-compacted gravel subbase. Tops of concrete pads shall be level. Conduits for primary, secondary, and grounding conductors shall be set in place prior to pouring of concrete pads. Concrete shall be 2,500 psi minimum at 28 days. Transformers shall be secured to the mat by a minimum of four 1/2-inch galvanized anchor bolts.

Padlocks shall be provided for pad-mounted compartmental transformer station.

PART 3 - EXECUTION

3.1 METER SOCKETS

Meter sockets shall be installed on the power company's last pole before the delivery pole at the outlet works and on the Glenrock gage house.

3.2 GROUNDING

A. All service equipment, conduit systems, supports, cabinets, equipment, transformers, fixtures, etc., shall be properly grounded in accordance with the latest issue of the National Electrical Code. Provide all bonding jumpers and wire, grounding bushings, clamps, etc., as required for complete grounding. Route ground conductors to provide the shortest
and most direct path to the ground electrode system. All ground connections shall have clean contact surfaces, tinned and sweated while bolting. Install all ground conductors in conduit. Ground the conduit enclosing the conductor as well as grounding the conductor. Bond the service equipment to a separate grounding electrode per National Electrical Code requirements. All ground conductors shall be insulated.

B. Provide a separate grounding conductor, securely grounded on each side of all raceways containing sections of plastic, or flexible raceways. Size in accordance with the National Electrical Code and route outside raceway.

C. Provide a green grounding jumper from the ground screw to a box grounding screw or clip for all grounding type devices. Use insulated wire. Devices with "Automatic Grounding" features will not serve as a satisfactory substitution for this requirement.

D. Provide a grounding type bushing for all feeder conduits which originate from the main switchboard and individually bond these raceways to the ground bus.

E. The grounding system shall be tested, using the fall of potential method, in the presence of the Owner. If the grounding system does not meet N.E.C. requirements, additional ground rods shall be added at no additional cost to Owner.

3.3 MOTOR STARTERS
-----------------
Install motor starters where indicated on the drawings with the top of the trim 6'-0" from the finished floor unless otherwise noted.

3.4 BRANCH PANELBOARDs
---------------------------
A. Install panelboards with the top of the trim 6'-3" from the finished floor.

B. Field check all panelboard loading and reconnect circuits as required to provide balanced phase and line loads.

C. Cables installed in wiring gutters of panelboards shall be neatly bundled, routed, and supported. Minimum bending radius as recommended by the wire and cable manufacturer shall not be reduced.

3.5 DRY-TYPE TRANSFORMERS
-----------------------------
Connect with a 24" long liquid-tight conduit connections to the transformer. Provide cut sections of Korfund "Elasti-rib" for all contact areas between wall and floor and mount in such a manner as to reduce sound transmission from transformer to surrounding media.

A. Any transformer causing objectionable sound will be required to be replaced at no additional cost to the Owner.

B. Bond across transformer to assure proper equipment grounding.
C. Set taps under load conditions for correct voltage.

3.6 AUTOMATIC TRANSFER SWITCHES

Mounting and connection shall be per manufacturer's recommendations. All control interlocks between the engine-generator set and the transfer switch shall be coordinated with the generator set manufacturer's recommendations and the transfer switch manufacturer's recommendations.

Engine-generator set combustion/cooling air supply and exhaust damper actuators shall be interlocked to the transfer switch to activate on normal source failure.

3.7 POWER TRANSMISSION EQUIPMENT

Install crossarms, surge arresters, primary-fuse cutouts, conductors, stresscones, and hardware as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure equipment complies with requirements. Set poles a depth of 6-1/2 feet in normal firm ground. In rocky or swampy ground, pole-setting depth shall be respectively decreased or increased accordingly and as approved by the Owner. Poles shall be set to maintain as even a grade as practicable. Holes shall be dug large enough to permit the proper use of tampers to the full depth of the hole. Earth shall be thrown into the hole in 6-inch maximum layers, then thoroughly tamped before the next layer is thrown in. Surplus earth shall be placed around the pole in a conical shape and packed tightly to drain water away from the pole.

Install stress cones for all termination of 15 KV shielded cable.

3.8 TESTS

After the complete power distribution system installation is completed, and at such time as the Owner may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this set of specifications. The test shall be performed in the presence of the Owner. The manufacturer of the main switch gear and motor control center shall have a certified technician field inspect the completed installation, calibrate and place into service all metering and ground fault equipment, certify the operation of the ground fault system per the NEC, and instruct the operating personnel in the proper operation and maintenance of the equipment.
SECTION 16D - ELECTRICAL, GENERAL LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section of Specifications shall consist of performing all labor and furnishing all materials, fixtures, and equipment necessary for a complete and operating lighting system.

1.2 CONDITIONS

The conditions shall be as specified in Section 16A of this set of specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical, General Requirements: Section 16A.

B. Basic Materials and Methods: Section 16B.

PART 2 - PRODUCTS

2.1 LUMINAIRES

Provide lighting equipment as shown in the fixture schedule on the drawings and as specified herein. Provide complete lighting equipment, including canopies, suspensions of proper lengths, supporting brackets, hickeys, casings, sockets, holders, reflectors, ballasts, diffusing materials, louvers, lamps, recessing boxes, etc., all wired, assembled, and ready for operation. Suspended luminaires shall be supported by metal stems; chain will not be acceptable.

2.2 INSTALLATION

Units to be installed in a damp or wet location shall be constructed with proper gasketing and corrosion resistant materials and/or coatings.

2.3 SURFACES

Provide all ferrous metal surfaces with a protective finish having rust inhibiting properties. Painted finishes shall be a minimum of 1.5 mils thick and shall have a balance between hardness and bending properties suitable for the application. White finishes shall have a 87% minimum reflectance.

2.4 FIXTURE WIRE

All "fixture wire" shall conform to the latest requirements of Underwriters' Laboratories and be concealed within fixture construction.
2.5 PLASTICS

All plastics used for light transmission shall be 100% virgin acrylic and 0.125 inch minimum thickness. No blends or copolymers shall be permitted. All plastics shall be ETL certified as light stabilized, nonyellowing. Aging properties shall be guaranteed to be in conformance with IES, SPI-NEMA minimum standards.

2.6 BALLASTS

Ballasts furnished shall meet Underwriters' Laboratories specifications for class P listing and applicable ANSI standards ballast specifications. Provide CBM-ETL certified, high power factor ballasts which will operate on nominal applied system voltage variation, and which conform with current applicable UL designated Class P requirements. All ballasts shall have automatic resetting type thermal protectors (for the coil) and a nonresetting protector (for the power capacitor).

2.7 LAMPS

Lamps shall bear labels of General Electric, Westinghouse, Norelco, or Sylvania, and be per Westinghouse lamp designations shown in the fixture schedule.

PART 3 - EXECUTION

3.1 MOUNTING

A. Set luminaires true, free of light leaks, warps, dents, or other irregularities. Provide the length of stems as required to hang all luminaires level and in the same horizontal plane. Mount all fixtures at position and height to clear equipment, ductwork, piping, etc.

B. Surface-mounted fixtures containing ballasts shall be mounted with a minimum 1 1/2 inch spacer where mounted in a combustible material unless specifically approved for the application.

C. Support luminaires only from structural elements which are capable of carrying the total weight. All luminaires shall be mounted rigidly, with no "rocking" action.

D. Protect wiring with tape or tubing at all points where abrasion is likely to occur. Provide chase nipples where field wiring through knockouts.

E. Install all lamps in accordance with the types indicated in the Fixture Schedule.

3.2 WIRING

Provide wiring and connections to all luminaires utilizing conventional conduit and wiring methods as indicated on the drawings and elsewhere in these specifications.
3.3 TESTS

After the lighting systems installation is completed, and at such time as the Owner may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this set of specifications. The test shall be performed in the presence of the Owner.

End of Section
SECTION 16E - ON SITE POWER GENERATION

PART 1 - GENERAL

1.1 DESCRIPTION

This section of the specifications shall include furnishing and installing all equipment, accessories, and other materials as shown on the Drawings and specified herein. It is the intent herein to describe a complete engine generating unit, including all necessary equipment and accessories, suitable for the intended service. Any omission in specified equipment will not relieve the supplier of the responsibility for furnishing a complete plant, including all items required for automatic and manual starting and normal operation. The unit shall consist of engine-generator set, all aligned, secured, and dowelled on a substantial base fabricated of structural steel. The unit shall be designed for automatic operation and furnished with all apparatus for control of the engine and generator as specified herein. All equipment shall be new, of standard manufacture, and in accordance with the applicable requirements of AIEEE, NEMA, and ICEI.

The unit shall be manufactured by a firm recognized as experienced and skilled in production of engine driven generating units, which firm maintains an engineering and service organization of skilled electrical and mechanical personnel.

1.2 CONDITIONS

The conditions shall be as specified in Section 16A of this set of Specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical, General Requirements: Section 16A.
B. Basic Materials and Methods: Section 16B.
C. Service and Distribution: Section 16C.
D. Instrumentation and Control: Section 16F.
E. Plumbing: Division 15.
F. Insulation: Division 15.
G. Liquified Petroleum Gas Storage: Division 15.

1.4 SUPERVISION

The equipment manufacturer shall furnish the services of an engineer to check the installations after completion and to supervise the placing of the equipment into service. The generating units shall be furnished ready for operation as soon as connections have been made to wiring system and the fuel, heating, cooling, and exhaust systems.
1.5 TESTS

The engine generator unit shall be tested in the field and at place of manufacture, together with its generator controls and its engine automatic start-stop controls. Starting time after initiation of starting impulse and including time to attain full speed and rated voltage shall not exceed ten (10) seconds as required by the latest NFPA Bulletin No. 76. Owner's representative reserves the right to witness these tests. Certified copies of the test logs and data shall be furnished to the Owner.

A. Factory Tests.....Each factory test shall be a continuous run test, one hour at 50% and two hours at 100% generator rating. All tests shall be made at 1.0 PF.

B. Field Tests.....Upon completion of the installation at the job site, a full field test shall be performed on the generator set. The tests shall include the following:

1. Five (5) hour load test on the generator set, 4 hours at 80% required KW, 1 hour at 90% required KW. Load banks shall be provided by the generator supplier and specified load shall be made at 1.0 PF.

2. One (1) hour load test of actual building loads simulating power outages and all specified control sequences.

3. At the completion of the field test, the fuel filters, oil filter and crankcase oil shall be changed.

4. Contractor shall furnish all fuel for field testing and fill fuel storage to capacity at completion of field tests.

1.6 SHOP DRAWINGS

Shop drawings shall include catalog cuts and descriptive data for each product. If catalog cuts are finished, the specific model number and all requirements shall be identified on each copy of the shop drawings.

1.7 WARRANTY

Equipment furnished and installed under this section shall be guaranteed against defective parts, workmanship, and installation for a period of two years after final acceptance and shall cover full parts, labor, and additional testing if deemed necessary by the Owner.

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR UNIT

A. Generator.....The generator shall be a single bearing synchronous type built to NEMA and ASA Standards as manufactured by Caterpiller or Owner approved equal.

The generator ratings at 7,000 feet above sea level and an ambient temperature range of -30 to 100°F for continuous standby service shall
be as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>480/277 V, 3Ø, 4 wire</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Continuous KW</td>
<td>113</td>
</tr>
<tr>
<td>Continuous KVA</td>
<td>125</td>
</tr>
<tr>
<td>Maximum KW</td>
<td>115</td>
</tr>
<tr>
<td>Maximum KVA</td>
<td>173</td>
</tr>
<tr>
<td>Power Factor</td>
<td>0.80</td>
</tr>
<tr>
<td>RPM</td>
<td>1200</td>
</tr>
<tr>
<td>Fuel</td>
<td>LPG</td>
</tr>
<tr>
<td>Efficiency</td>
<td>90 percent (min.)</td>
</tr>
</tbody>
</table>

Generator shall be revolving field brushless alternator type with Class F insulation used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. The generator shall include a resettable thermal protector for exciter/regulator protection against extended low power factor loads. The generator shall be ten-lead, y-connected.

B. Regulator.....A generator-mounted, volts-per-hertz-type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be +2% from no load to full-rated load with droop-type governor, or +1% with an isochronous governor. Readily accessible voltage drop, voltage level, and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of +5%. The solid-state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration.

C. Engine.....The engine shall be the watercooled inline or Vee-type, four-stroke cycle spark ignition. It shall meet specifications when operating on liquid petroleum gas. Equipment for cooling shall include a fan and radiator with ethylene glycol coolant, suitable for -40°F operation.

In no event shall the horsepower required by the generator specified herein exceed the engine manufacturer's continuous duty rating (per current published bulletins and power curves) after allowance has been made for cooling fan, pump, and other power consuming engine accessories, 100°F ambient temperature, and operation at 7,000 feet above sea level.

The engine shall be equipped with filters for fuel, lube oil, and combustion air, lube oil cooler, and gear-driven water pump. Air filter shall be dual-stage.

The engine governor shall maintain frequency regulation within +3% from no load to full-rated load and shall be as manufactured by Woodward Governor or an Owner approved equal.

The unit shall be mounted on a structural steel subbase and shall be provided with suitable vibration isolators.
Safety shutoffs for high water temperature, low oil pressure, overspeed, high oil temperature, and engine overcrank shall be provided.

Thermostats and contacts shall be provided to open the motorized dampers when the engine coolant reaches operating temperature of 165° F or as recommended by the engine manufacturer, or open the dampers on high room temperature as indicated on the Drawings.

D. Fuel System. The fuel system shall be as required for a complete and operating system in accordance with NFPA-58, Liquefied Petroleum Gases, and shall include the following:

1. Fuel strainer; cone type for LPG liquid.

2. Automatic Fuel Shutoff. Provide normally closed solenoid valves at the inlet to the standby power building and at the inlet to the carburetor. Solenoid enclosure shall be NEMA Type 4. Solenoid valve shall be electrically compatible with the engine-generator ignition system. Solenoid valves shall be UL approved for LP fuel service, both liquid and gaseous.

3. Dry element air cleaners.

4. LPG storage tank gauge as specified in Division 15 of these Specifications.

5. LPG storage tank, storage tank valving as specified in Division 15 of these Specifications.

6. Piping, fittings, and all other appurtenances necessary for a complete and operating fuel system as specified in Division 15 of these Specifications.

7. Fuel vaporizer shall have an outlet pressure compatible with the engine supplied for -40° F liquid propane. Vaporizer shall be remote mounted.

E. Exhaust System -

1. Exhaust Silencer. Provide a 6" Ø outlet, dual inlet, industrial degree exhaust silencer, with condensate drains including flexible exhaust fittings. Verify size and install according to the manufacturer's recommendation. Mounting shall be provided by the installing contractor. The silencer shall be mounted so that its weight is not supported by the engine. Verify exhaust pipe size to be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer. Provide pipe as required.

2. Insulation. The muffler and all indoor exhaust piping shall be insulated by the installing contractor to maintain a surface temperature not to exceed 150°F (65.5°C). The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fittings or condensate drains.

F. Automatic Starting System -
1. Starting Motor.....A DC electric starting system with positive engagement drive shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

2. Automatic Controls.....Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, high oil temperature, overspeed, over-cranks, and one auxiliary contact for activating accessory items. Controls shall include six 15-second cranking periods with lockout.

3. Jacket Water Heater.....A unit-mounted thermal circulation-type water heater(s) incorporating a thermostatic switch for automatic starting and stopping shall be furnished to maintain engine jacket water at a temperature sufficient to start engine in an ambient temperature of -30°F at 208V, 1 phase. Circuiting for two 3,000 watt heaters is provided for in the Drawings. Contractor shall be responsible for making changes required for heater(s) supplied at no additional cost.

H. Batteries -

1. Batteries.....Thick plate nickel-cadmium storage batteries to be used in conjunction with the electric starting system shall be provided. The batteries shall be rated by the battery manufacturer in accordance with requirements set forth by the engine manufacturer. The batteries shall be capable of starting the generator at 20°F. A battery rack and necessary cables and clamps shall be provided. Battery cables shall be sized to prevent excessive voltage drop for remote mounted batteries. Cable length is approximately 20 feet.

2. Battery Charger.....The dual rate charger and heater shall employ transistor-controlled magnetic amplifier circuits to provide continuous taper charging and shall maintain rated output voltage within +1% from no load to full load.

2.3 GENERATOR CONTROL CONSOLES

A. Accessibility.....All equipment housed within the enclosure shall be easily accessible for adjustment. Enclosure shall be NEMA Type 12 rated.

B. AC Output Instruments and Instrument Switches.....Instruments shall be of the flush mounting type calibrated for use in a steel panel. Full load values shall show at approximately two-thirds full scale. AC ammeters with scales beyond 50 amperes shall be for use with current transformers. Instruments shall have an accuracy within plus or minus two percent of full scale reading. The following shall be furnished:

1. Dual range AC voltmeter.
2. Dual range AC ammeter.
3. Meter switch, voltmeter-ammeter phase selector switch with an off position.
4. Voltage adjusting rheostat.

5. Frequency meter, dial type, (45-65 Hz).

6. Running time meter.


8. Dry contacts for remote indication of alarms and status, wired to terminal strips.

C. Automatic Engine Controls.....Automatic engine controls shall be housed with the generator controls and shall be designed for use with the engine described in these specifications. All equipment shall be of high quality. Timing devices shall be motor driven or pneumatic, diaphragm actuated, snap action switches; no thermal or magnetic timers will be permitted.

All devices except those which mount on the front panel shall be assembled together on a steel subpanel within the engine-generator control panel enclosure. Interconnections between components shall be neatly cabled and secured to the face of the subpanel. External connection terminal strips shall be mounted on the subpanel for connecting the control leads to the engine and to the devices on the front panel.

1. Operation.....The controls are to act to start the engine in the shortest possible time after receipt of the signal to start, which will consist of the closure of an external circuit operated at battery voltage through contacts on the automatic load transfer switching equipment. Cranking is to commence and is to continue until the engine starts and runs, but not for a longer cranking period than approximately 15 seconds (adjustable to seconds). If the engine fails to run within this period, cranking is to be discontinued for 15 seconds, then cranking shall commence again. The control shall lock itself out after six attempts and require manual resetting. The generator shall start when the control building or standby power building calls for heat or when a valve is to operate and normal power has been interrupted. Other conditions for starting and stopping are called out on the Drawings.

2. Selector Switch.....A three-position selector switch marked "run-off-remote" shall be mounted on the front of the control console. In the "Remote" position the controls shall be in readiness to start the engine upon signal. In "Run" position it shall start the engine and maintain the engine running until the switch is returned to the "Off" or "Remote" position. When returned to the "Off" position, the engine shall shut down. When returned to the "Remote" position, engine operation shall be determined by the automatic transfer switch control.

3. Solid-State Engine Monitoring System.....Solid-state engine monitoring shall provide automatic shutdown for overcrank, overspeed, high coolant temperature, and low oil pressure. Monitoring system shall have individual fault lamps, mounted on the control console's front panel, for each of the above fault conditions. A lamp test switch shall be provided on the front of the control console.
The lamps shall burn to indicate that the control equipment is locked out for trouble indicated.

4. DC Engine-Controls.....Oil pressure gauge and coolant temperature gauge shall be provided to monitor the respective conditions and shall be flush mounted on the front of the console panel.

D. Automatic Voltage Regulator.....The voltage regulator shall be capable of holding the AC voltage within the limits of plus or minus two percent from no load to full load. Regulator shall not be connected line to neutral on 3 phase, 4 wire circuits.

E. Current Transformers.....Current transformers shall be of the donut types, securely mounted on the conductors and of sufficient capacity to operate instrument and current overload relays.

F. Wiring.....All wiring shall be installed in a neat and workmanlike manner. Clearly marked terminals shall be provided for all external connections. A complete wiring diagram shall be furnished which shall clearly identify each lead in the circuit by a number, and correspondingly numbered adhesive strips shall be affixed to the individual wires for identifications.

G. Circuit Breakers.....Control panel shall include a three-pole, molded case circuit breaker sized to protect the generator. The load side lugs of the circuit breaker shall be suitable for connection of the size and number of conductors shown on the Drawings.

H. Tests.....The completed control equipment shall be tested with the engine-generator set prior to shipment and installed in the field. These tests shall include repeated starts and stops to demonstrate the action of the control equipment under all possible conditions, such as momentary closure of the external circuit, reclosure of circuit during shutdown timing, etc.

PART 3 - EXECUTION
---------------------------------------------------------------
3.1 GENERAL
---------------
Generator sets shall be installed at the locations indicated on the Drawings in strict accordance with the details and the manufacturer's instructions and directions. Installations shall include the standby electric generating sets, complete exhaust systems, heat recovery system, complete fuel systems, and all appurtenances necessary for complete and operating electric generating systems.

The electric generating sets shall be mounted on manufacturer furnished spring type vibration isolators.
The generator set manufacturer shall provide the services of a factory trained engineer to instruct the electrical contractor and coordinate the installation. He shall assist in placing the equipment in operation and provide instruction to the operating personal.

End of Section
SECTION 16F - INSTRUMENTATION AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

This section of the Specifications shall include the design, fabrication, installation, and testing of all hardware and software required for the implementation of a complete and workable supervisory control and data acquisition system. This section includes Specifications for the central direct digital control system and associated peripheral equipment, operator stations, the remote terminal units, and other appurtenant equipment required to provide a complete and workable system. A single control supplier shall be responsible for coordination of all phases of the work including interfacing of equipment, equipment testing, operator training, and system checkout during the warranty period.

A. Supervisory Control and Data Acquisition System... The supervisory control and data acquisition system shall include the installation and commissioning of a computer directed data acquisition and processing system for the Deer Creek Reservoir raw water system. The system shall include all necessary peripheral equipment and remote terminal units for monitoring and control of the process.

1. The functional requirements of the system are summarized as follows:

a. The scheduling of communications with remote sites on a sequential basis.

b. The automatic conveyance of data to and from remote sites.

c. Processing of all data by digital computer.

d. On-demand display of all pertinent operating parameters by use of CRT monitors.

e. Logging and reporting of specified data for historical records, process summary reports, trend analyses, etc.

f. Log running time for specified equipment and schedule periodic maintenance.

g. Remote terminal units capable of industrial I/O interfacing, and data processing and storage.

2. The supervisory control and data acquisition system shall include but not be limited to the following items.

a. Computer and associated peripheral devices.

b. Computer software necessary for the accomplishment of the specified tasks.
c. Operator station complete with colorgraphic CRT terminal and alarm and report printers.

d. Microprocessor-based remote terminal units.

e. System installation and start-up.

f. System management and engineering.

3. The supervisory control and data acquisition system shall be as manufactured by BIF Accutel; a unit of General Signal, or an Owner approved equal.

4. This section of the Specifications shall also include the connection of the following remote mounted equipment to the remote terminal unit and testing of the complete control and monitoring system.

a. Flow Transmitters.

b. Valve operators and position transmitters.

c. Reservoir Level Transmitters.

d. Standby Engine Generator Set.

e. Temperature Control Systems.

f. Intrusion Detection Systems.

Furnish all connections, wiring and appurtenant equipment required for proper operation and interconnection of integral and remote equipment.

1.2 CONDITIONS

The conditions shall be as specified in Section 1.D, General Requirements.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical, General Requirements: Section 16A.

B. Basic Materials and Methods: Section 16B.

C. On Site Power Generation: Section 16E.

D. Temperature Control: Division 15.

1.4 QUALITY ASSURANCE

A. Factory Test....Factory tests shall be performed as specified in Part 3.3B of this section of these Specifications to assure proper operation of each component before shipment to the job site or installation in control panel enclosures.

B. Applicable Standards -
2. Instrument Society of America (ISA).
4. Institute of Electrical and Electronic Engineers (IEEE).

1.5 SUPERVISION

It is the responsibility of the General Contractor and his subcontractors to install all equipment in strict accordance with manufacturer's recommendations, with adequate on-site supervision being provided by the manufacturer of the equipment or his authorized representative.

The authorized representative of the manufacturer(s) supplying equipment shall notify the Owner that the equipment has been satisfactorily installed and is ready for operation. No form of energy shall be applied on to any part of the instrumentation and control system prior to receipt by the Owner of a certified statement of approval of the installation from the Contractor containing his supplier's authorization for applying energy to the system. The system supplier shall provide system start-up assistance by factory trained engineering and programming personnel.

The testing and start-up supervision shall continue until the system is in proper operating condition as determined by the Owner.

1.6 SHOP DRAWINGS

Shop Drawings shall be submitted in accordance with the General Requirements, Section 16A of these Specifications for all products listed in Part 2 of this section.

1.7 INSTRUCTION BOOKS

Instruction books shall be submitted in accordance with the General Requirements, Section 16A of these Specifications.

PART 2 - PRODUCTS

2.1 CENTRAL CONTROL SYSTEM

A. System Hardware - General.....A direct digital control system shall be furnished as specified herein. The hardware shall, in its initial configuration, have the capability of performing all specified functions. Computer resident memory, external mass memory, and I/O interface equipment shall be capable of field expansion by modular units to meet the future requirements of the system.

1. Central Processing Unit (CPU).....The CPU shall have a minimum word length of 16 bits and shall have a minimum extended 22-bit addressing capability. The multifunction CPU shall include the following features:
a. Instruction Set.....The basic machine instructions shall allow byte and word addressing in both single and double-operand formats to simplify the implementation of controls and communications applications. The instruction set shall also include arithmetic, conditional, branch, jump and subroutine, trap, memory management, and floating point instructions.

b. Memory Management.....The memory management feature shall provide memory relocation, segmentation, and protection in a multiprogramming environment. The processor shall operate in two modes: supervisory and user.

In supervisory mode the software shall have complete control and shall execute all instructions. Monitor and supervisory programs are executed in supervisory mode.

In user mode the software shall be executed in a restricted environment and shall be prevented from executing certain instructions that could be destructive to the software system, i.e. modification of a supervisory program, halting the computer, or using memory space assigned to other users. The memory management shall enable the 16-bit processor to address the full complement of resident memory as specified herein.

c. Interrupts.....The CPU shall be capable of hardware implementation of external interrupts. Interrupt priorities shall be programmable.

d. Power/Fail Restart.....A microcoded power fail procedure shall be initiated whenever power sequencing signals indicate an impending AC power loss. This shall cause the microprocessor to trap to a defined location, enabling it to execute a powerdown routine and an orderly system shutdown. Upon power restoration the computer shall automatically restart and resume program execution.

After coming on line the computer shall provide an alarm message indicating that a power fail/restart has occurred. The computer shall also execute a complete RTU status update.

e. Resident Memory.....Resident memory equal to 150% of the initial system requirements and not less than 512K bytes shall be provided. The CPU shall be capable of being equipped with up to two (2) times the amount of memory required for the initial system including initial spare memory.

Direct memory access (DMA) operation and full memory parity shall be provided with the resident memory.

f. Mass Memory Device.....The mass memory device unit(s) shall be a sealed hard disk drive unit(s) of Winchester technology. The mass memory device unit(s) and associated controller shall have a minimum of 40 megabyte capacity.

The disk storage memory subsystem shall provide for storage of data base parameters, historical data, and inactive system programs.

g. Floppy Disk Drive.....A floppy disk drive subsystem shall be provided to
facilitate the archiving of historical data and also as a backup system to the mass memory device. The floppy disk drive shall utilize standard double-sided, double density flexible media with a minimum storage capacity of 1 megabyte.

h. Master Terminal Unit (MTU).... The MTU shall function as a front end communication processor interfacing the central computer system to the remote terminal units (RTU). The MTU shall relieve the central computer system of the burden of the routine polling and communications responsibilities. The MTU shall maintain the most current data received from the RTU's and shall handle the various peripheral tasks such as selective polling sequencing. The MTU shall perform all system communication functions as specified in this section of the Specifications.

i. Floating Point Processor..... A floating point processor shall be provided to operate with the CPU to execute all arithmetic operations of the floating point instruction set.

2. Peripheral Equipment -

a. Colorgraphic CRT Console..... The colorgraphic CRT console shall provide the process operator with monitor/control interface to the process. The colorgraphic CRT console shall provide numerous functions including display group, historical trending, dynamic trending, alarming, alarm summaries, activate/deactivate points, etc.

The console shall be configured as a CRT monitor with a typewriter-like keyboard. The monitor screen shall be a minimum of 19 inches diagonal.

The colorgraphic CRT monitor shall have a high resolution 384H x 480V grid area and a display format of 80 characters x 48 lines. The character set shall include 64 standard ASCII characters and 512 software programmable characters. Individual characters shall consist of a 6 x 8 dot matrix with all 48 dots addressable by software. Characters shall be displayed in eight foreground and background colors. The data refresh rate shall be at least 60 times per second.

The keyboard shall be equipped with 192 ASCII codes and cursor control. The keyboard shall also be provided with numeric and color select key clusters and 16 special function keys. Keyboard addressable editing functions shall include tab, insert/delete - character/line, cursor control, color selection, transmit, page roll, etc.

The console shall be RS232C compatible with seven programmable communications rates from 100 to 9600 baud. Communication modes, serial, full duplex, half duplex and local transmission, are all programmable.

The colorgraphic CRT console shall be as manufactured by Intelligent Systems Corp., Series 8000, or Owner approved equal.

b. System Console Printer..... Printer shall be a freestanding send-receive printing terminal provided with integral countoured typewriter-style keyboard and paper catch tray. The printer shall meet or exceed the
following specifications:

1. 7 x 7 Dot Matrix character font.
2. 180 character per second bi-directional print speed.
3. 7-bit ASCII character set.
4. Operator selectable line density: 2/3/4/6/8/12 LPI.
5. Operator selectable character density: 5-16.5 CPI with a minimum of 132 characters per line.
6. Tractor drive or pin feed platen.
7. 1K character buffer.

Boot, halt, and diagnostic routines shall be performed at the system printer. The printer shall be as manufactured by the Digital Equipment Corp., Model LA120 Decwriter 111 or Owner approved equal.

c.Alarm/Event Printer.....Alarm/event printer shall be a freestanding receive only printer with integral paper catch tray. The printer shall meet or exceed the following specifications:

1. 7 x 7 Dot Matrix character font.
2. 180 character per second bi-directional print speed.
3. 7-bit ASCII character set.
4. Operator selectable line density: 2/3/4/6/8/12 LPI.
5. Operator selectable character density: 5-16.5 CPI
6. 1K character buffer.

All operator selectable printing configurations shall be hardware set. Alarm/event printer shall be as manufactured by Digital Equipment Corp., Model LA120 Decwriter III or Owner approved equal.

3. Power, Physical, and Environmental Requirements -

a.AC Power.....The AC power to the central control system shall be 120 VAC, 60 HZ, single phase.

b.Uninterruptible Power Supply (UPS) System.....UPS system shall be capable of serving 120% of the central control system electrical load (CPU and all peripherals including front end communications processor, mass storage devices, radio communications equipment, CRT terminal, and printers) for a period of 10 minutes to 87.5% of battery voltage.

UPS system including inverter, battery charger, transfer equipment and batteries shall be designed for maximum reliability in emergency service and shall be designed with modular construction for easy field
maintenance. All solid state components shall be rated at twice the actual duty requirements. The system shall be designed to operate from 120 volt, single phase, 60 hertz under both normal and emergency conditions.

The DC to AC inverter shall be of the solid-state type with ferroresonant output transformer. The output voltage shall be regulated to within +5% from no load to full load at unity power factor over the entire range of input battery voltage and the frequency shall be regulated within +1 hertz. Total conversion efficiency shall be within 75% minimum and shall have a sine wave output with less than 5% total harmonic distortion. Self protective features shall include automatic 130% current limit, short circuit protection, fail-safe start-up, automatic low battery shutdown, and reverse input polarity protection. The input power and control circuitry shall be separately fused.

AC to DC converter shall be capable of keeping battery fully charged during time utility power is on and supplying DC power to inverter input to prevent interruption of AC load power. System shall incorporate a steering diode method of switching upon loss of utility AC and shall be equipped with an automatic bypass switch in the event of inverter malfunction.

The battery shall be sized to power the fully loaded inverter for 10 minutes. The battery shall be of the sealed lead acid type with no outgassing. Batteries shall be integral to the UPS system.

Instrumentation and controls shall include a ready normal power "ON" light, charge light, inverter supplying load pilot light, and test switch to test system operation.

Entire system shall be enclosed in a sheet steel enclosure suitable for mounting in the central system console desk. UPS system shall be as manufactured by Sola, a Unit of General Signal or Owner approved equal.

c.Power Line Conditioner.....The power line conditioner shall provide instantaneous voltage regulation and isolation from both transverse and common mode noise for the central control system. Output voltage regulation shall be within +3% for an input voltage variation of up to +15%. The output shall remain within NEMA voltage Specifications for Input voltages as low as 65% of nominal. Common mode noise rejection shall exceed 120 dB and transverse noise rejection shall exceed 60 dB. The line conditioner shall be sized for a load of 150% of initial system load. The line conditioner shall be hard wired and shall be as manufactured by Sola, a unit of General Signal, Series 63 or an Owner approved equal.

d.Load Center.....Load center shall be 120 VAC, single phase equipped with molded case circuit breakers, as required to distribute 120 VAC power to all associated loads at the central system. Load centers shall be installed in the console desk at central system. Power line conditioners shall feed the load centers. Load centers shall be as manufactured by Square D or Owner approved equal.

e.Physical.....The central control system desk shall house the CPU, mass
memory devices, peripheral interface units, resident memory, power supply, cooling fans, UPS system, and integral bus backplane. The central control system manufacturer shall provide and install a complete set of cables to interconnect the system devices. These cables shall be multiconductor and shielded where necessary. Cable retention shall be provided by multipin connectors with locking clips.

f. Environment.....The operating environment of the central control system shall be 10°C to 40°C, 10% to 95% relative humidity at an elevation of 4900 feet.

B. System Software-General.....All standard and application programming necessary to provide the functions specified shall be provided by the manufacturer. Certain of the required software items are described below, but this description in no way relieves the manufacturer from supplying all programming that shall be necessary to provide the monitoring, logging, and control functions specified.

The software system provided shall be capable of controlling the computer in a multiuser, multitasking real-time environment and shall provide a high level control language allowing the operator to communicate with the system using common English terminology.

1. Real-Time Executive.....The real-time executive shall provide resource and task management services to the CPU and peripheral devices while many users simultaneously perform on-line, real-time tasks. The real-time executive as a minimum shall include the following features:

a. A priority scheduler that assigns a numerical priority value to each task and schedules the task for execution under that value. In addition, the priority level assigned to a task may be reset to a higher or lower priority each time it is scheduled for execution in response to a dynamically changing situation by the executive or the system operator.

b. Task management function that shall allow the CPU to link and execute several computer programs as one unit at run time. The task management function shall monitor the system resource needs of each particular task such as memory space requirements or disk or terminal requirements. Tasks shall be initiated on an elapsed time basis, on an event basis, or on request of a previously initiated task.

c. System security function that shall define privileged and nonprivileged users, commands, tasks, and terminals.

Data files shall be protected from unauthorized access. The different access types shall include read, write, extend, and delete.

d. An executive routine command language which shall provide the system operator with an interface to the executive. Some of the command language functions shall include install, run, or abort a task; partition memory task space sizing, naming and position; assign a logical device to an actual physical device; alter a task's priority from a previously set value; etc.
2. Programming Languages.....The system software shall support assembly language and Fortran. Programming language compilers shall be provided to allow machine reconstruction of all application software.

3. High Level, Process Control Language -

a. General.....A field proven supervisory control and data acquisition software package shall be provided which is fast, efficient, and versatile for process control and monitoring applications. The supervisory control and data acquisition system shall include a flexible analog and digital scan and alarm program. A CRT program shall be available supported by a set of standard operator display command functions. The following information shall be interpreted as the minimum to be supplied under the process control software package. The software package must consist of the following functional units:

A process scan and alarm package which shall perform acquisition of analog and digital data from the process.

Algorithms which shall perform calculations based on input values. These algorithm outputs shall be used in process monitoring and reports.

CRT handler which shall process requests into the computer via the CRT keyboard.

A utility package which shall allow editing of existing data tables and loading of new programs.

A historical data management package which shall allow historical data recording and graphic trend display of historical data.

Report generator package shall provide the capability of on-line report generation from any CRT terminal.

b. Process Scan and Alarm.....The scan system shall provide a sequential site-by-site interrogation of the remote terminal units (RTU's) throughout the process. The central control system shall address each RTU individually using an RTU unique address code. After communications has been established and verified by both the central and the RTU, a complete process data update shall ensue.

The scan system shall be capable of establishing RTU communications via the radio communications network. The RTU's communicating with the central via the radio communications network shall be sequentially interrogated on a continuous basis.

The scan system shall read and convert the process inputs, make calculations based on this input data, and monitor the process. Each input or output, or calculated value shall be assigned an internal point number corresponding to the alphanumeric symbolic name used for external identification.

An input processor shall be provided which shall convert the raw ADC count values to engineering ranges, read and store current values, and process specific functions.
c. Calculator Algorithms.....A number of algorithms shall be provided in the system for the determination of calculated point values. The algorithms shall use a mixture of laboratory data and field input data as inputs for the calculation. "Laboratory data" shall be considered as any data that is manually entered via a CRT console keyboard. The outputs of these algorithms will typically be used in routine reports. The calculating processes shall use arithmetic functions including addition, subtraction, multiplication, division, square root, exponential, trigonometric functions, logarithmic functions, and logic functions.

A sample of the different types of "calculator" algorithms required of this system is as follows:

Calculating flow totalization from instantaneous values.

Determining minimum, maximum, and average values of an analog variable over a period of time.

Comparing current analog values to predefined limit setpoints.

Determining channel flows from the channel depth and a depth vs discharge channel calibration curve.

Data reduction techniques required for historical data accumulation.

Display graphic trend of current values.

d. Operator's Console Handler.....A standard software package shall be provided to handle operator requests for display and change of system information using the operator's console. A library of standard functions shall be provided including:

- Display all parameters of a point
- Change parameter of a point
- Display a group of points
- Assign a process variable to a display group
- Display all alarmed points
- Display all bad inputs
- Set time or date
- Display menu
- Select graphics
- Select logs
- Display/Log preventive maintenance summary
- Enter/Display laboratory data
- Enter/Display log data
- Select periodic log/report interval
- Display equipment out of service
- Select periodic interrogation interval

e. Point Descriptors.....Each point in the system shall be specified including a point name of up to 6 characters and a point description of up to 24 characters in length.

f. Historical Data Management Package.....The historical data management
package shall provide the system with the capability for:

Saving the values of process variables when they change significantly.

Maintaining these data values for online direct access.

Displaying the saved data in color graphic form on the operator's console.

Archiving the saved data for permanent storage on offline media.

Restoring selectively the archived data for subsequent display or analysis.

Generating printed reports from either online or offline historical data.

Managing the online and offline historical data files.

The historical data recording process shall utilize a data compression technique to reduce the storage requirements for the historical data. Averaging systems shall not be permitted.

The presentation of the historical data shall include graphic and summary report formats. The system shall be capable of displaying trend graphics of process variables on the CRT. The system shall also provide a summary report that represents a generalized analysis of a process variable over a period of time. The summary report program shall compute the average, maximum, and minimum values and average deviation for each point over a selected time period. The historical data analysis shall be available for any time period that the data exists online to the historical data base.

Provision shall be made to allow the historical data to be copied to offline storage media such as a floppy disk. Headers shall be written to fully define the archived data for future reference. The system shall be capable of restoring the archived data to the online disk files from the offline floppy disk system.

Report Generator Package.....This software package shall provide the capability of online report generation from a CRT terminal. The report generator shall output reports up to 132 columns wide and unlimited in length of any standard listing device. Reports shall be processed on demand or placed in a report queue for processing at a specific time and date.

Data entries in reports shall be derived from field input data, laboratory data, calculated data, or a combination thereof. Any data entries that are unavailable at the time of printing of the report shall be indicated by an asterisk (*).

A default value shall be provided for laboratory data that shall be utilized in all report entry calculations that the actual laboratory data has not been entered in the system.
Reports may be deleted from or added to the system at any time by the system programmer. Report formats or entry derivations may be changed by the system programmer.

4. Operational Description: Process Management -

a. General....All functions of the process management utility must operate without interfering with the data acquisition functions. The system shall have the capability of implementing the generation and/or reporting of any process management function without taking the data acquisition system out of operation or delaying the execution of any data acquisition function.

The process management functions shall include but not necessarily be limited to the CRT formats, logging formats, and lab data entry capabilities listed and described in these Specifications.

b. CRT Formats - Operator Interface....A colorgraphic CRT shall be provided with the system as described in the hardware section of this Specification. The CRT shall provide an interactive interface with the plant operator to yield an efficient error-free operating system.

The CRT display system shall visually indicate the status of the plant operation utilizing graphic symbols as well as providing alphanumerical information.

The CRT shall be provided with the software required to generate the page formats as hereinafter described.

For maximum security in all operator actions, the method of control shall utilize the "echo back before execution" technique which allows the operator to verify any command before execution. The conversation between the operator and the computer shall be interactive and shall utilize English language statements easily understood by the operator.

Master Page Display - This page shall consist of an index of all other pages available in the system. If the list of pages exceeds the capacity of one page, this fact shall be noted on the screen, and other pages will be provided to list the complete index. Using the "Select" line on the screen and/or the function buttons on the keyboard, the operator shall be able to call up any page listed on the master page.

Point Display - Any point in the system shall be capable of being displayed on the CRT screen. When the point is called up for display, all parameters associated with the particular point shall be displayed on the screen. Each entry on the screen shall be labeled and shall be presented with proper engineering units.

Any operator entered change to any parameter for any point shall be automatically documented with a hard-copy log on the alarm logger which describes the change, the time when it occurred, and the operator identification.

Group Display - This display shall consist of a group of 8 associated analog variables. The analog variables shall be displayed in bar graph
format. Any analog variable shall be capable of being displayed on the group display pages. All analog variables shall appear with the associated current value displayed in alphanumeric form with associated engineering units. Alarm setpoints and the status (inactive, normal, or alarmed) of each analog variable shall also be indicated on the group display. Analog variables displayed on the group display shall be continuously updated by the central control system.

An index of group displays shall be provided for ease in selecting the group to be displayed.

Alarm Display.....The alarm display shall consist of CRT page(s) which provide a convenient list of all points which are presently in an alarm state. If there are no alarmed points in the system, the display shall indicate this. If there is more than one page of alarmed points to be displayed, the "next page" destination shall appear, and the operator shall be able to call up the additional pages by pressing one of the keyboard function buttons. The alarms shall be displayed in the order of their occurrence.

Each line on the screen shall contain all of the following information which is pertinent to the type of point:

- Time of Alarm
- Point Mnemonic
- Point Description
- Current Value or Status
- Engineering Units
- Alarm Condition
- Alarm Limit Violated

Time and Date Display - This page shall consist of a display of the time of day in hours, minutes, and seconds and the date showing month, day, and year. The operator shall have the ability to modify the time and date by entering new data via the CRT keyboard.

The time and date of the last system update shall appear on each CRT display, in addition to the current time and date.

Log Select Display - The system shall provide the operator with the capability of requesting any of the logs or report through the CRT keyboard.

Lab Entry Display - The CRT shall be utilized by the operator to enter laboratory analytical results and data into the computer for use in calculations and logging. A list or index of lab data formats shall be provided. Each lab data page shall be designed so that entry of data into the computer will simply be a matter of calling up the appropriate CRT format onto the screen and entering the numerical values into the format.

CRT keys shall be used to select a lab data menu. The operator shall then select the appropriate lab data category.

All lab data entry displays shall be time tagged with date and time.
All unentered data entries on an entry display shall be displayed as asterisks (*) or the default value, if available, shall be displayed.

Maintenance Summary Display - The colorgraphic CRT shall be used to display a summary of all maintenance data for each equipment item which appears on the maintenance log.

The CRT display shall indicate, for each point, the device description, the maintenance tasks, the accumulated running hours, the maintenance interval, the dates on which the last previous maintenance was performed, and the run time hours since last maintenance.

This format shall provide the operating and maintenance personnel with the capability of:

- Modifying specified maintenance intervals.
- Modifying running times in the event of a computer failure which might result in erroneous totals.
- Acknowledging the fact that maintenance duties were completed.
- Modifying maintenance task descriptions.

Log Correction Display - This function shall be provided to allow the operator to enter data for periods during which an individual sensor or the entire system has been down.

A menu page shall be provided to select the appropriate log. The CRT shall then request the operator to enter a point name and respond with a display. The operator shall then select the item(s) which he wishes to correct via CRT keyboard.

Process Graphics - Process graphic diagrams shall be provided which illustrate the process. One graphic format shall be provided for each section of the process. The process graphic diagrams shall consist of displays of major processes. The diagrams shall be formatted with lines illustrating process lines and special characters illustrating major process elements such as pumps, valves, flow meters, etc. Live real-time analog values shall be displayed on the CRT screen for each analog input included on that particular process diagram. Any analog or status inputs that are in an alarm state shall be flashing until acknowledged. Point and/or loop designations shall be shown for each process component.

Process graphics shall be generated and displayed via a color CRT with graphic capabilities.

Analog Trend Display - An analog trend display subsystem shall be provided to allow the operator the ability to plot any selected analog variable on the CRT screen. Trends shall be represented by single point plots or bar graphs.

The trend background information shall consist of an x-axis and a y-axis.
upon which the variables shall be plotted. The x-axis shall represent
the time interval and the y-axis represents the values. The horizontal
axis shall provide a minimum of 48 point positions to provide a smooth
curve. If a bar graph representation is to be used the number of plot
groups must be entered.

Data for the trend plots shall be taken from the historical data base.
Every analog variable for which historical data exists shall be
available for trending over any time interval. The minimum time
interval shall be 1 hour.

The operator shall be able to select up to four analog variables to be
overlayed on the same coordinate background. Each analog variable
displayed shall be identified on the display by the corresponding
variable name.

Set point limits shall be identified on all trend displays. Whenever
the value of the process variable exceeds the setpoint limit a different
color shall be used to identify that portion of the plot.

Any of the parameters for a particular variable, average, maximum,
minimum, and standard deviation, may be plotted with the trending
subsystem.

c. CRT Print Function.....The system shall allow the operator to print any
of the aforementioned CRT displays on the logging printer. This
function shall be performed by the depression of a console "Print"
function key and shall include all alphanumeric data presented on any
CRT display format and hardcopy reproduction of all graphic characters.

d. Logging Capabilities Required.....The computer system shall provide data
logging capabilities as hereinafter described. Log programs shall be
provided which shall gather data for logs from files, prepare and group
points for listing, and perform any calculations as required.

The following logs shall be output by the logging program:

<table>
<thead>
<tr>
<th>Alarm and Alarm History</th>
<th>Daily Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>Monthly Summary</td>
</tr>
<tr>
<td>Maintenance Summary</td>
<td>Periodic Log</td>
</tr>
</tbody>
</table>

Alarm Log - The purpose of alarm logging is to inform and record for the
operator any potentially upsetting event that can be recognized by the
computer. The computer system shall periodically test for the
occurrence of such events, and upon recognition of an alarm shall type
an alarm printout and sound an audible alarm. An alarm message shall be
added to the CRT alarm summary and shall be displayed on the operator's
CRT upon request. An alarm silence function key shall be provided for
audible alarm silence.

Alarm messages shall be printed on a change-of-status (normal to alarm
or alarm to normal) basis, and except for operator-requested alarm
summaries, no alarm messages shall be typed for a particular condition
for which a normal or alarm condition continues.
Alarm logging software shall include the following types of alarm categories:

Contact Change of Status - Alarm messages shall be typed for alarms detected by a digital status point changing state. These are of two types: the first being the changing of a status point which should not change and the second being a status point not changing state when commanded to change state. Examples of these two types are intruder detection and pump failure to start.

Instrument Range Violation - Instrument range violation conditions are defined for analog input signals outside of full scale range, and indicate possible instrument or signal transmission malfunction. All analog input signals shall be tested for range violation at each scan and an alarm message shall be generated for each "Bad Value" input.

High-Low Process Limit Violation - High-Low limit violations are defined for analog input signals and occur when the variable is within the instrument range as described above but the value is either greater than the "High" or less than the "Low" process alarm limit entered by the operator for that particular variable. Each analog input or computer variable shall have associated high and low process alarm limits stored in memory subject to display and modification by the operator. Alarm messages shall be generated for all limit check violations.

Rate of Change Process Limit Violation - Rate of change limit violations are defined for analog input signals and occur when the value of the variable changes at a rate exceeding the rate of change limit entered by the operator for that particular variable. Rate of change limits shall be stored in memory and shall be subject to display and modification by the operator.

Analog Deviation - Alarm messages shall be typed for alarms detected by an analog variable changing value by a pre-set percentage of full scale. An example of this type of alarm is a valve position changing due to valve operator drift.

The alarm message format shall be as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Point ID</th>
<th>Point Description</th>
<th>Value</th>
<th>Error</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALM 1905:10</td>
<td>PL1LEV1</td>
<td>Reservoir Level</td>
<td>28.5</td>
<td>LOLIM</td>
<td>30 Feet</td>
</tr>
<tr>
<td>ALM 1910:20</td>
<td>PL1DIS3</td>
<td>Discharge Flow</td>
<td></td>
<td>Bad Input</td>
<td></td>
</tr>
<tr>
<td>ALM 0101:30</td>
<td>LP1YHD1</td>
<td>Hydraulic Pump</td>
<td>Fail</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where the first point is an analog limit violation, the second point is an instrument range violation and the third point is a contact change of state.

A summary of alarm conditions for the current 24-hour period shall be printed upon demand from the CRT. The log shall consist of a summary of all points currently in alarm in the order of their occurrence, oldest alarm being printed first. The printout shall contain the time that the point went into alarm.
Once each day an alarm history log shall be printed. This log shall list all alarms that occurred in the past 24 hours and the number of occurrences of each.

Periodic Log - The periodic log shall be automatically printed at operator selected intervals which shall be adjustable via the operator's console. The intervals shall be adjustable up to 24 hours.

For each analog point, the following information shall appear: current value in engineering units, average, maximum and minimum since the last listing. For selected points the accumulated total and their associated engineering units shall also be printed. For digital points the current status shall be printed.

Average, maximum, and minimum values for analog variables shall be calculated based on a 24-hour period starting at 12:00 midnight of each day. The printing of the periodic report shall not affect these calculations. A periodic report that has been printed prior to the end of the 24-hour recording period shall reflect the average maximum and minimum values of all variables up to the time of printing.

The log shall include the time and date of printing and description for each point. Bad measurements or inactive points shall be denoted by an asterisk (*). All analog data shall be printed in up to six significant digits in associated engineering units.

The points logged on the periodic log shall be grouped in accordance with logical sections of the process. Each group of points shall be preceded by a subheading which describes the following group.

The operator shall have the ability to request a periodic log at any time, regardless of whether or not the log period has elapsed. The operator shall be able to demand this log through the CRT console. The format and content of the log shall be identical to that of the periodic log. An operator requested periodic log shall not affect the timing interval of the automatic printing of the periodic log.

Maintenance Logging - A maintenance log shall be provided to indicate elapsed running times of selected pieces of equipment to be scheduled for maintenance. The computer shall read the contact inputs of the designated equipment and determine whether the equipment is "ON" (in service) or "OFF" (out of service). Capability shall be provided to log points which are not "wired", via use of the real time clock to determine run times.

A program executed daily shall compare the accumulated running hours against preset limits which indicate "next time to service". Each piece of equipment shall have one or more maintenance tasks to be performed at certain elapsed running times. The computer system shall print a daily report on the logging printer containing information on which maintenance tasks for which equipment items are overdue.

When a maintenance task is performed, the operator's CRT keyboard will be used to indicate completion. This shall reset one run time counter, and the last date the task has been performed shall be set to the
current date. A second run time counter shall be non-resetting and shall report total accumulated run time on the equipment. The resettable run time counter shall log run time up to 9999.9 days. As maintenance task completion is acknowledged, it shall be logged on the event printer.

The maintenance tasks in the program shall be grouped in accordance with logical sections of the process.

The format of a maintenance work order printed daily shall be similar to the following:

MAINTENANCE WORK ORDER
DATE: 1-26-86

<table>
<thead>
<tr>
<th>Point</th>
<th>Description</th>
<th>Limit (Hours)</th>
<th>Time Since Last Service (Hours)</th>
<th>Total (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator</td>
<td></td>
<td>100</td>
<td>101</td>
<td>124.9</td>
</tr>
</tbody>
</table>

Maintenance Task No. 121
Change Line Filters
Check Oil Level
Note - Disconnect power before working on equipment
Last Date Serviced - Jan. 22, 1986

The maintenance task description shall be formatted for up to five lines of instructions. The last date serviced line shall be updated whenever the task completion is acknowledged. The text shall be accessible to the operator for editing. Security against inadvertent changes shall be provided using a confirm requirement before the revisions are entered into the program. Total run time in days may be logged as a separate record accessed through the operator CRT.

The maintenance program shall be configured for 100 maintenance tasks with provisions for future expansion to 1000 tasks.

The system shall permit the operator to obtain a complete listing of the maintenance log for editing and review off system.

Maintenance Summary Log - The operator shall be able to request an orderly printout of all maintenance data files. The report shall contain the current time of day and shall consist of a list identifying:

The total elapsed running time.
The "next time to service" limit.
The elapsed time since last time task was performed.

The date of the last previous performance of a maintenance task.

The report will not include the text of the maintenance task instructions. It is intended for use as a scheduling tool for major tasks and a record of maintenance status on various pieces of equipment.

Summary Reports - The computer shall generate process summary reports on a periodic basis. The reports shall provide an orderly presentation of the process data for the particular reporting period. Report data entries shall be derived from field input data, laboratory data, calculated data, or historical data. All report data entries shall be in correct engineering units in values up to six significant digits.

Certain reports shall be derived from an accumulation of entries from other reports, i.e. a monthly summary report may be an accumulation of daily summary reports.

Operator Security - The operator shall be required to log on to the system via an assigned password. Each operator shall also be assigned a priority level establishing the bounds of access throughout the system. Logging on/off the system shall be recorded on the alarm/event log.

Control Displays - Control displays shall be generated via the graphic display generator which allows the operator control of remote valves and standby power generator. Each valve control and generator control function shall have priority access levels assigned to them.

2.2 REMOTE TERMINAL UNIT

A. RTU Hardware - General....The RTU shall be a microprocessor based system device capable of performing all specified functions. The RTU shall be of modular construction and shall consist of the following circuit card assemblies:

1. Digital (Contact) input card.
2. Digital (Contact) output card.
3. 4-20mA analog input card.
4. 4-20mA analog output card.
5. Microprocessor control card.
6. Watchdog timer.
7. Modem card.

B. Circuit Card Requirements -

1. Microprocessor Control Card.....The microprocessor control card performs communications control activities and input/output (I/O) signal handling. The processor card shall consist of a microprocessor and
on-board memory. The on-board memory shall contain the executive routine, all operational programs necessary for system restart after power failure, and the scratch pad memory for local calculations. The processor addressable memory shall be capable of being expanded to a minimum 48 K bytes.

The processor card shall be RS 232C compatible and shall have software selectable baud rates ranging from 110 to 19.2 K baud.

2. Digital Input Card.....The digital input card shall accept and condition digital (contact closure) input signals. Digital inputs shall be dry rated contact closures referenced to power supply ground, or 10-32 VDC, or 90-140 VAC.

3. Analog Input Card.....The analog input card shall accept and condition 4-20mA analog signals. Signal conditioning shall include analog-to-digital conversion with a 12-bit resolution and linearity of 0.25% of full scale.

4. Digital Output Card.....The digital output card shall generate digital output signals. The digital output signal shall be optically isolated from the external process signal lines and shall be dry rated contact closures, 10-32 VDC, or 90-140 VAC.

5. Analog Output Card.....The analog output card shall be 4-20mA analog signals. Each output shall have independent zero and full scale adjustments and shall have a 500 OHM driving capability. The digital-to-analog conversion shall have a resolution of 12 bits with a system linearity of 0.25% of full scale.

All RTU circuit card assemblies shall be provided with remote terminal cards and interconnecting ribbon cable assembly. Circuit cards shall be mounted in a card cage with integral control, power, and data bus. The circuit cards shall be physically and electronically compatible with the bus to allow circuit card mounting in any card cage slot.

6. Watchdog Timer.....Watchdog timer card shall monitor the activity of the microprocessor control card. In the event of a processor failure the watchdog timer shall initiate an entire system reset causing the processor to be reset.

7. Modem Card.....Modems shall provide a means of digital data modulation/demodulation suitable for radio transmission. Modems shall be two frequency, FSK type modulation capable of 300 bit/second data transmission rate. Modem shall also be compatible with two way radio equipment providing transmitter keying and squelch delay.

C. Power, Physical, and Environmental Requirements -

1. Power.....All system power shall be derived from 120 VAC, 60 Hertz. Regulated DC power supply shall provide low voltage DC power to the circuit cards, modems, and DC-DC convertor. DC power supply shall be provided with integral line isolation and voltage regulation for suppression of voltage transients and surges caused by lightning strikes, network switching, or motor starting. Output voltage
regulation shall be within +3\% of nominal. The line isolation shall provide for transverse and common mode noise rejection.

The DC-DC converter shall provide multiple DC output voltages required for control and power of the circuit cards and modem. All output voltages shall be electrically isolated from the input power. Regulated outputs shall have foldback current limiting protection.

2. Back-up Power Source....A back-up power source shall be provided with Deer Creek Reservoir Outlet Works RTU that shall supply power to the RTU for a period of 48 hours during utility power failure. The back-up power source shall be provided with an automatic "bumpless" transfer switch and integral battery charger. Batteries shall be maintenance free and shall operate in ambient temperature of 0 to 70°C.

3. Physical....All RTU hardware shall be housed in a NEMA 12 enclosure as specified in Part 2.5 of these Specifications. All process connections shall be made at the remote terminal cards mounted on the back panel.

4. Environmental.....The RTU shall operate in an ambient temperature of 0 to 70°C.

D. RTU Software Requirements, General.....The RTU system software resources shall be oriented toward local process control, supervision, and data acquisition and reduction. Certain of the required software items are described below, but this in no way relieves the manufacturer from supplying all programming that shall be necessary to provide the monitoring and control functions specified.

1. Real-Time Executive.....The real-time executive shall provide resource and task management services in a multitasking environment. The real-time executive as a minimum shall include the following features:

a.Priority scheduling and task management shall allocate microprocessor resources and memory space on a priority basis. Task management shall also allow intertask signaling. Tasks shall be initiated on an elapsed-time basis, on an event basis, or on request of a previously initiated task.

b.Interrupt processing shall service high priority interrupts and preserve the status of the processor and the contents of the registers until the interrupt processing is complete and the processor control is returned to the interrupted program.

2. Arithmetic subroutine shall provide addition, subtraction, multiplication, and division functions as a minimum.

3. Analog variable monitoring and processing routines shall include the following features:

a.Collection of raw data from analog input cards and storing the data in memory.

b.Conversion of the raw-value analogs to engineering unit representations.
c. High/Low limit parameters with alarm and control functions. Analog variable setpoints shall be adjustable via the serial communications channel.

d. Analog variable blocking function shall allow an operator entered value to be downloaded to an RTU for use in all analog processing routines during times of instrument failures.

e. Analog data accumulation shall provide analog variable storage at the RTU. Predefined analog process variables shall be stored in memory in the event of a communications failure. A data compression technique may be utilized to minimize required storage space. The data storage procedure shall be a first in/first out routine to allow storage of the more current values should the duration of the communications failure exceed the capabilities of the RTU. The RTU shall have memory sized to store critical process variables for a minimum period of two weeks.

4. Library of communication routines shall be required for the following communication functions:

a. Modem control, including radio transmitter keying and squelch delay.

b. Address recognition.

c. Abort timer disconnect.

d. Communication failure and recall.

e. Data send/receive.

5. Executive routine command language shall give the system programmer access to the real time executive including system calls to start and stop tasks, invoke time delays, process interrupts, etc.

6. Memory access routine shall provide access to data stored in RAM memory at an RTU from the serial communications channel.

7. Data transmission security shall be enhanced through the use of an error detection encoding/decoding routine.

2.3 MINI-REMOTE TERMINAL UNIT (RTU)

A. The mini-RTU shall be a microprocessor based single board device capable of performing all specified functions. The mini-RTU shall consist of four functional circuits: modem, DC-DC converter, microprocessor, and input/output.

1. The microprocessor circuit shall perform communications control activities and input/output signal handling. The processor circuit shall consist of an 8-bit microprocessor with an available 8K bytes of on board memory. The processor memory shall contain all operational programs necessary for system restart after power failure. The processor shall provide the data set control for the modem. Communications functions shall include:
a. Modem control, including radio transmitter keying and squelch delay.
b. Address recognition.
c. Abort timer disconnect.
d. Communication failure and recall.
e. Data send/receive.

2. Input/Output circuit shall include:
   a. 16 discrete contact or status inputs.
   b. 8 discrete solid state outputs.
   c. Capability to add 4 analog inputs (10 bit conversion).

3. The power supply circuit shall convert normal line power to a single DC voltage. Power for all the various circuits shall be derived from this single voltage.

2.4 SYSTEM RESOURCE CONFIGURATION

This part of the Specifications shall describe how certain of the system resources specified in Parts 2.1, 2.2 and 2.3 of this section of the Specifications shall be configured to implement the communications networks, operator interfaces, and process interfaces. This description does not detail the resource management services, data acquisition and control functions, or other support functions required for a complete supervisory control and data acquisition system; however, this in no way relieves the manufacturer from supplying all software and hardware that shall be necessary to provide the monitoring, logging, and control functions specified.

A. Central Control System.....The central control system shall provide resource management functions, data acquisition and processing functions, report, graphic, and log generation, operator interface, communications through a high level process control language, and communications control as specified herein. The software and hardware package shall be tailored to perform all specified functions and to facilitate the expansion of the system to include the areas of anticipated future growth. The functional requirements of the central control system shall be as follows:

1. Resource Management.....The central control system shall operate in a multiuser, multitasking real-time environment. This type of operating environment shall require management of system resources such as memory space, data bus, peripherals, etc. The central control system shall execute the data acquisition polling and communications routine while simultaneously servicing multiple local and remote users. User tasks shall be assigned priority levels and shall be executed on the basis of priority level and system resource availability.

2. Communications.....The central shall communicate with remote sites via
the radio communications network. The central shall provide the control required for modem data sets to operate on the specified communications medium.

Communications transmission rate between the central and each RTU shall be 300 baud.

Communications with the RTU’s shall originate at the MTU and shall occur on a sequential site by site polling basis. The MTU shall attempt to establish communications with a RTU a minimum of five times before a communication failure alarm occurs. The communication failure alarm shall be output on the alarm log printer.

The polling sequence shall be interrupted when an operator control request is made of the Deer Creek Reservoir Outlet Works RTU. A value control request shall sustain communications with the Deer Creek Reservoir Outlet Works RTU for a period of twenty minutes or until the operator discontinues the value control function.

3. Reports, Logs, and CRT Graphics Format Definition

This section of the Specifications shall define the field input data, laboratory data, calculated data, and formats required for generation of the system reports, logs, and process graphics.

a. Reports -

Daily Report - The daily report shall be a 24 hour listing of hourly maximum, minimum, average, and totalized values for the following analog variables. Each report shall have a single summary for each 24-hour period indicating the maximum, minimum, average and totalized values for the 24-hour period. The variables included in the report are:

Deer Creek Reservoir Elevation
Deer Creek Reservoir Storage
Low Discharge Pipeline #1 Flow
Low Discharge Pipeline #2 Flow
Deer Creek Above Reservoir Head
Deer Creek Above Reservoir Flow
West Fork Deer Creek Head
West Fork Deer Creek Flow
Deer Creek Below Reservoir Head
Deer Creek Below Reservoir Flow
Deer Creek At Glenrock Head
Deer Creek at Glenrock Flow

Report Entry Derivations are as follows:

1) Deer Creek Reservoir Elevation - Deer Creek Reservoir Elevation shall be defined as the Deer Creek Reservoir Water Level plus an operator defined zero datum elevation.

2) Deer Creek Reservoir Storage - Deer Creek Reservoir Storage shall be defined as the water volume corresponding to the reservoir elevation. The reservoir area-capacity tables defined on the Contract Drawings shall be utilized as a look-up table in determining reservoir storage.
Straight line interpolation shall be used to determine reservoir storage values corresponding to elevations that fall between the increments given on the area capacity tables.

3) Low Discharge Pipeline #1 Flow - Low Discharge Pipeline #1 Flow shall be derived from the Low Discharge Pipeline #1 flowmeter at the Reservoir Outlet Works.

4) Low Discharge Pipeline #2 Flow - Refer to number 3 above.

5) Deer Creek Above Reservoir Head - Deer Creek above reservoir head shall be derived from the stream water level transmitter at the Deer Creek Gaging Station above the Reservoir.

6) Deer Creek Above Reservoir Flow - Deer Creek above reservoir flow shall be derived from an operator entered look-up table of stream head vs stream flow. The flow rate table shall be entered via the CRT console. A flow rate table shall be established for each of the stream flows identified herein. The number of flow vs head points for each table shall be operator selectable from 0 to 50. The engineering units for head shall be feet and for flow shall be cubic feet per second (cfs). A flow rating curve shall be approximated by a series of straight lines joining the programmed flow vs head table entries. A straight-line interpolation shall be performed for any stream head value that falls between two programmed table entries. The first and last points programmed shall define the variable range for validity limit checking.

7) West Fork Deer Creek Head - Refer to number 5 above.

8) West Fork Deer Creek Flow - Refer to number 6 above.

9) Deer Creek Below Reservoir Head - Refer to number 5 above.

10) Deer Creek Below Reservoir Flow - Refer to number 6 above.

11) Deer Creek at Glenrock Head - Refer to number 5 above.

12) Deer Creek at Glenrock Flow - Refer to number 6 above.

The daily report shall be produced automatically at midnight of each reporting period.

b. Logs -

Alarm Log - The alarm log shall be formatted as specified in Section 2.1B.4 of these Specifications. All alarm events shall be as described on the Drawings.

Maintenance Log - The maintenance log shall be of two types—a maintenance work order and a maintenance summary log. The maintenance work order shall be printed on a time queue basis. The maintenance summary log and the maintenance work order shall be printed on operator command from any operator station.

c. CRT Formats -

16F-25
Group Display - A group display shall be generated for each RTU. Each analog variable at an RTU shall be displayed in the RTU group display. The group display shall use the data values from the most recent interrogation.

Point Display - The point display shall be generated for each process variable in the system.

Alarm Display - The alarm display shall be generated for each process variable that has a possible alarm condition.

Maintenance Summary Display - The maintenance summary display shall display all maintenance data for each equipment item identified in the maintenance log listing. The maintenance summary display shall be formatted to group equipment items by corresponding RTU.

Process Graphics - Process graphics shall be developed to depict the actual process at the RTU's.

Analog Trend Display - All analog process variables representing flows or levels shall be incorporated in the trending function.

Report Display - All reports shall be available for display on the CRT.

B. Remote Terminal Units (RTU).....The RTU's shall provide local control and data acquisition functions, data processing and storage, and communications and computer interface to the physical processes at each remote site. All process variables for each RTU shall be as indicated on the Drawings. The functional requirements of the RTU's shall be as follows:

1. Deer Creek RTU.....The outlet works RTU shall monitor and control the reservoir outlet works storage and discharge processes, the standby power system, and associated support systems. The communications shall be via the radio communications network. The RTU shall be located in the Deer Creek Control Building. The RTU functional requirements shall be as follows:

a. Analog Variable Processing.....The analog variable signal format shall be limited to 4-20mA signals.

Analog variables representing process flows shall be recorded as instantaneous flow values and totalized flow values. The instantaneous flow data may be reduced to the average instantaneous flow value over a one hour period with a corresponding maximum and minimum value over the same period. The RTU shall generate a running totalized value for each process flow variable. The analog variable representing the reservoir level shall be recorded as instantaneous values only. The recorded history of data values and totalized values shall be transmitted to the central system at each interrogation.

The RTU shall not be required to accumulate a history of data values for the remaining analog variables (valve positions, control building ambient temperature). The instantaneous value of each of these analog variables shall be transmitted to the central system at each
b. Standby Power System Control and Monitoring.....A contact closure output shall be utilized for standby power system control. During a utility power failure the RTU shall initiate the standby power generator start sequence under the following two conditions:

If the RTU receives a request for a data update from the central or a request to execute a control function, the RTU shall respond by initiating the generator start sequence and advising the central that the generator must be brought up and the instrumentation stabilized before the RTU can respond with valid data. The RTU shall allow 30 minutes for instrumentation stabilization after the generator has started. After the 30-minute stabilization period has expired, the RTU shall transmit a request for interrogation to the central system. The data update or control commands shall be executed, and the generator shutdown sequence shall begin.

A generator start/stop sequence shall also be initiated by an operator command entered into the system via a CRT keyboard. An operator commanded start-up or shutdown shall override all of the other start and shutdown sequences.

The generator shutdown sequence shall include a 5-minute running cooldown period prior to actual shutdown. The 5-minute running cooldown period shall be generated by the RTU. If the RTU receives a start generator command during the cooldown period, the shutdown sequence shall be aborted, and the generator shall continue running until the shutdown sequence is initiated again.

The RTU shall monitor generator status and alarm conditions. The RTU shall also monitor generator ignition system battery voltage. A battery voltage sensor integral to the generator shall provide a contact closure input to the RTU upon low battery voltage. The generator battery status shall be monitored by the RTU at all times, i.e. during utility power failure.

c. Valve Position Control.....The valve position control shall be of three types:

Manual Control (Time Proportional)
Position Feedback Closed Loop Control
Flow Proportional Position Closed Loop Control

Each valve shall be operated from "open/close" contact closure outputs.

Position transmitters at each valve shall generate 4-20mA position indicating signals that shall be interfaced to the RTU. Limit switches on several of the valves shall be used to indicate the fully travelled position.

Manual Control Time Proportional Mode - In the manual control mode the RTU shall receive an input data value from the central system representing a travel time in the open or closed direction. The RTU shall execute the control command and continuously update the valve
Position Feedback Closed Loop Control Mode - In the position feedback control mode, the RTU shall receive an input data value from the central system representing a percentage of fully open valve position. The RTU shall open or close the valve accordingly until the corresponding valve position feedback signal is within ±2% of the requested position.

Flow Proportional Position Closed Loop Control Mode – In the flow proportional position control mode the RTU shall receive an input data value from the central representing a process flow rate. The position of the valve which controls the particular process flow rate shall be modulated until the actual process flow rate is within ±2% (full scale range of flow) of the desired flow rate. The flow proportional control mode shall function to position the valve at the requested flow proportional position and then shall be terminated. After the initial positioning of the valve, any changes in the process flow rate due to changing process operating conditions shall not affect the positioning of the valve until another flow proportional position control command is received by the RTU.

In both closed loop control modes, communications with the central shall continue until the valve is correctly positioned.

d. Digital Input Processing.....Digital inputs (contact closure inputs) shall represent status or alarm signals for the various physical processes. All the digital inputs to be interfaced to the Deer Creek RTU shall be as indicated on the Drawings.

The RTU shall derive from the status inputs the accumulated run time for certain equipment items. The run times shall be transmitted to the central system for use in maintenance scheduling and logging.

2.5 CONTROL PANELS AND ENCLOSURES

The panels and enclosures shall be totally enclosed cabinet type with front door and continuous hinge, 3-point latch and key-locking handle, and equipment mounting panels, and shall be of NEMA type 12 rated construction.

Enclosures shall be provided with horizontal mounting channels, one swing-out panel where required for front panel mounting of equipment (i.e. push buttons, indicators, etc.), and one stationary panel as indicated on the Drawings.

Enclosures shall be of sufficient size to accommodate the panel mounted equipment specified.

Enclosures and panels shall be 14-gauge (minimum) steel and of formed and welded construction suitable for wall mounting.

Enclosures' interior finish including mounting panels shall be white enamel. Exterior finish shall be gray low-gloss industrial lacquer 1 mil dry.

16F-28
The panels shall be furnished with internal condensation heater and thermostat of sufficient size to maintain the relative humidity in the enclosure within the specified operating limits of the equipment housed by the enclosure.

Control panel enclosures shall be as manufactured by Hoffman Engineering Company or an Owner approved equal.

2.6 PANEL MOUNTED EQUIPMENT

A. Nameplates....Nameplates shall be laminated phenolic sheeting with white core and a black satin finish melamine overlay. Nameplates shall be 0.040 to 0.045 inch thick. Legend engraving shall be through the overlay to expose the core, and all edges shall be beveled to expose the core on the perimeter.

B. Terminal Blocks.....Terminal blocks for all external connections shall be rated at 300 volts. Terminal blocks for internal panel connections of AWG #12 conductor and smaller shall be rated at 300 volts. White terminal marking strips indicating point identification and diode or capacitor polarity shall be installed on each terminal block. Terminal blocks shall include fusible terminal block sections where a control voltage source exits the enclosure for a remote location. Terminal blocks shall include disconnect switch terminal block sections, suitable for interrupting control voltages, where a control voltage source enters the enclosure from a remote location. Terminal blocks shall be as manufactured by Buchanan, Square D Co., General Electric, or an Owner approved equal.

C. Fuse Holders.....Fuse holders for AC and DC instrument systems shall be Buss Snap-Lock type HLD fuse holders or an Owner approved equal.

Each major equipment component shall be individually fused per the manufacturer's recommendations.

Provide spare fuses for each AC and DC circuit. Spare fuses shall be stored in a spare fuse cabinet located inside the panel enclosure near the fuseholder mounting brackets.

D. Digital Panel Meters (Analog Input).....The digital panel meters shall be 0.6 inch high, 7-segment led with full-scale ranges as indicated on the Drawings. Panel meters shall be actuated by 4-20mADC input signals proportional to the process variable and shall contain all scaling electronics required to display the variable in the units indicated on the Drawings.

The digital panel meters' circuiting shall be all solid state utilizing dual slope A/D conversion with adjustments for zero and full scale.

Panel meters shall operate on 120 vac, 60 hz. Accuracy shall be ±0.5 count (maximum), linearity shall be ±0.5 count (maximum); input impedance shall be 10 OHMS; and the panel meters shall operate in temperatures of -10°C to 60°C and 0.90% relative humidity, noncondensing.
Digital panel meters shall be as manufactured by Electro-Numerics, Inc., Process Control Meter Series 4100 or an Owner approved equal.

E. Digital Panel Meter (BCD Input).....The digital panel meters shall be 0.6 inch, 7-segment LED with number of digits as indicated on the Drawings. Digital Panel Meters decoder/driver circuitry shall be all solid state with edge card connectors. Panel meters shall be actuated by TTL compatible binary coded decimal.

The digital panel meter shall operate in temperatures of \(-10^\circ C\) to \(60^\circ C\) and 0.90% relative humidity, noncondensing. Digital panel meters shall be as manufactured by Electro-Numerics, Inc. or an Owner approved equal.

F. Control Relays.....Control relay contacts shall be rated 20 amps, 250 vac. Relays shall be provided with coil voltages and contact arrangements required to implement the control functions indicated. Relays shall have integral dust cover and shall be as manufactured by Potter & Brumfield KR-KRP series, or an Owner approved equal.

G. Pushbutton Switches.....Pushbuttons shall provide control switching capability rated 60 ampere make, 6 ampere break at 120 volts AC. Pushbuttons shall be the heavy-duty oiltight type suitable for mounting in a 1-7/32 inch diameter notch type cover hole. Pushbuttons shall be momentary action.

Switch mechanisms shall contain the number of form "C" (SPDT) contacts required to perform the functions indicated on the Drawings. Contacts shall be silver.

Pushbuttons shall be provided with legend plates and colored caps. Legend plate engraving and cap color shall be as indicated on the Drawings.

Pushbutton switches shall be as manufactured by Square D Co., or an Owner approved equal.

H. Selector Switches.....Selector switches shall provide control switching capability rated 60 ampere make, 6 ampere break at 120 volts AC. Selector switches shall be the heavy-duty oiltight type suitable for mounting in a 1-7/32 inch diameter notch type cover hole. Selector switches shall be manual return.

Switch mechanisms shall contain the number of form "C" (SPDT) contacts required to perform the functions indicated on the Drawings. Contacts shall be silver.

Selector switches shall be provided with "Gloved Hand" operator knobs and legend plates. Legend plate engraving and color shall be as indicated on the Drawings.

Selector switches shall be as manufactured by Square D Co., or an Owner approved equal.

I. RTD Transmitter.....RTD transmitter shall accept inputs from resistance temperature detectors (RTD) and generate a 4-20mA DC output signal
linearly proportional to temperature. Transmitter output drive capability shall be a minimum of 600 ohms. The transmitter accuracy shall be within ±0.1% of full scale. Multiturn zero and span potentiometers shall provide output signal calibration control. The transmitter shall accept input from a 3-wire nickel RTD with a full-scale range of 0-120°F. Transmitter shall operate on 120 vac.

The transmitter shall be as manufactured by ACROMAG, Inc., Omega Engineering, Inc., or an Owner approved equal.

J. VHF Two-Way Radio Units.....The Flow Control Telemetry System shall utilize FM two-way radio communications for data transmissions between the MTU and the individual RTU's.

Radio units shall be combination transmitter/receiver (transceiver) compatible with MTU and RTU communication interface devices. Transceiver frequency range shall be 132-174 MHz. Transceivers shall be of all solid state construction suitable for operation in an ambient temperature range of 0°C to 70°C and a relative humidity of 0 to 90%, noncondensing. Transceivers shall operate on MTU and RTU power supplies.

Transceiver RF power output shall be as determined by the equipment manufacturer. MTU and RTU site locations shall be as indicated on the Drawings. Topographical Quadrangle maps of the project area are available through the United States Department of the Interior, Geological Survey, Denver, Colorado.

The Contractor shall be solely responsible for determining transceiver RF output power requirements, and antenna types and locations. The Contractor shall conduct a VHF Radio System Survey of the project area to determine RF power output and operating frequency of the transceivers.

Survey results shall be submitted with the Flow Control Telemetry System Shop Drawing Submittal.

VHF Transceivers shall be as manufactured by Motorola Communications and Electronics, Inc. or Owner approved equal.

K. Remote Alarm to Sheriff’s Office –

1. Receiving Board.....A Modularm No. 130 by Ademco is existing in the Sheriff’s Office and shall be used to receive the alarm from the central control system. The receiver is owned and maintained by Jeffers Electric located in Glenrock, Wyoming. Pay required fee for one year's use and maintenance of receiving board.

2. Components.....A 6VDC rechargeable power supply and a reversing relay for a reverse polarity supervised system shall be supplied to be compatible with the existing system. A normally closed dry contact that opens on alarm shall be provided in the Central Control System to initiate alarm.

3. Telephone Line.....A dedicated telephone line shall be wired to the
power source, reversing relay, and dry contact. This line is existing from the control room to the Converse County Office Complex telephone backboard. Extend line in control room as necessary. Arrange with the telephone company for a dedicated pair telephone line from the Office Complex to the Sheriff's Office.

4. Components shall be contained in the Control Console.

2.7 REMOTE MOUNTED EQUIPMENT

A. Bubbler Level Detection System...Bubbler level detection system shall include the compressed air supply, filter-regulator, filters, purge meter with differential pressure regulator, pressure to current transmitter, gauges, process piping, and appurtenances necessary for a complete and operating level detection system. All bubbler system components specified herein shall be sized and supplied by the bubbler system supplier.

1. Compressed Air Supply.....Compressed air shall be supplied from a dual compressor, one for air supply and the other for backup. Compressor operating parameters are as follows:

- Total Dynamic Head (Max.): 50'
- Maximum Measured Reservoir Level: 50'
- Process Piping Size: 1/2" I.D. Steel Pipe, or 1/2" Copper Tubing
- Ambient Temperature Range: 35°F to 100°F

Compressor shall be provided with disconnect and motor starter, alternator to alternate the lead compressor and backup compressor, controls to start the backup compressor with inoperative lead compressor, and contact for alarm when the lead compressor is inoperative. Compressor and compressed air receiver shall be sized for 50% running time.

2. Purge meter shall consist of a glass metering tube and ball type float housed in a high strength aluminum body. Purge meter shall have an integral needle type hand control valve.

Purge meter shall be suitable for panel mounting and shall be as manufactured by Fisher & Porter or an Owner approved equal.

3. Process piping shall be 1/2" O.D. Type L hard drawn copper pipe or 1/2" I.D. steel pipe as indicated on the Drawings.

a. Pipe shall be provided with all fittings and pipe clamps as indicated on the Drawings and as required for proper installation. All copper-to-copper connections shall be sweated connections.

4. Pressure to Current Transmitter.....Gauge pressure to current transmitters shall be direct pressure actuated through a bellous type sensing element. The DC output signal shall be a 4-20mAADC signal linearly proportional to the top 50 feet of reservoir level. The transmitter shall be capable of driving a 400 ohm load. The transmitter shall have an accuracy of +0.5% over a 10:1 range. Transmitter shall
operate on 120 VAC.

Transmitter shall be provided with a metal enclosure, NEMA Type 4 rating, and shall be as manufactured by BIF, or Owner approved equal.

5. Pressure gauges shall be 6-inch dial with stainless steel movement and shall have an accuracy of 0.1% of full scale. Gauges shall be as manufactured by Heise, Instrument Division of Dressor or an Owner approved equal.

6. Valves shall be Whitney Forge body valves with Swagelok fittings or an Owner approved equal.

7. Filter-regulator shall be comprised of four functional parts: a porous filter, a drip-well to collect condensed water vapor, an adjustable pressure regulator, and an output pressure gage. The drip-well shall be a transparent bowl with metal bowl guard and automatic float drain. Drain line shall be routed to drain into sump.

8. Filters shall include a porous filter, and a drip-well consisting of transparent bowl with metal guard and automatic float drain. Drain line shall be routed to drain into sump.

9. Operation.....Bubbler level detection system configuration shall be as indicated on the Drawings. Maximum operating range shall be 0-50 feet. Bubbler system shall be provided with a regulated pressure bypass line to permit periodic high pressure purging of the piping purge line. Static pressure sensing elements shall be isolated from the system during high pressure purging.

10. Testing.....All bubbler piping shall be hydrostatically tested for a period of 1 hour at 150% maximum operating pressure. Any leaks which are detected shall be repaired and the piping system retested.

11. Remote Indication.....The output of the pressure transmitter shall be connected to the main control panel with a number 18 AWG twisted shielded pair.

B. Pressure Gauge.....Pressure gauges shall have a 4-inch dial in readings of PSI with a stainless steel movement. Full scale shall be a maximum 15 psi. Gauge accuracy shall be within ±1% of full scale. Gauges shall be as manufactured by HAENNI Instruments, Inc., or an Owner approved equal.

C. Valves.....Valves shall be Whitney Forge body valves with Swagelok fittings or an Owner approved equal.

D. Process Piping.....Reservoir level transmitter processing piping shall be 1/2" O.D. Type L hard drawn copper pipe. Copper pipe shall be provided with all fittings.

E. Resistance Temperature Detector (RTD).....The RTD shall be a three-wire, nickel temperature sensor compatible with the RTD transmitter specified in this section of the Specifications. The RTD shall be lead wire resistance compensated and shall have a full scale range of 0-120°F.
The RTD shall be housed in a wall mounting enclosure and shall be as
manufactured by Burns Engineering, Inc. Model No. 9986 or an Owner
approved equal.

F. Solar Photovoltaic System.....A complete collection, storage and
distribution system shall be provided for the gage houses at the
following locations: Deer Creek in Canyon, Deer Creek above Deer Creek
Reservoir, and West Fork Deer Creek. The system shall include all
wiring, equipment and disconnects as required in accordance with NEC
Article 690. System shall provide power for a continuous load of 13.3
VA at 24 volts DC in a temperature range of -20°F to 80°F. The complete
system shall include, but not be limited to solar modules, support
structure, voltage regulator, battery, insulated battery enclosure,
battery cable, disconnect, and system wiring.

1. Solar Modules.....Solar modules shall be 36 watt, rigid metal
construction with low-iron tempered glass front and double peripheral
seal to provide moisture barriers. A weather resistant junction box
attached to the frame shall meet electrical codes. Modules shall
withstand ambient temperatures of -40°F to 140°F and wind resistance up
to 125 mph. Modules shall be Solavolt MSVM4020 or approved equal.

2. Support Structure.....Support structure shall accomodate the number of
modules required at the tilt angle as recommended by the manufacturer.
Structure shall withstand 125 mph wind loading and shall be Solavolt
MSVS1070 or approved equal.

3. Voltage Regulator.....The voltage regulator shall be for 24 Vdc
operation and shall feature temperature compensation, series regulation,
low battery voltage, load disconnect, water tight enclosure, and
automatic switching from 100% battery charging to trickle-charge mode.
Reclosure shall be Solavolt MSR24S10L or approved equal.

4. Batteries.....Batteries shall be lead acid, shall operate the system at
battery temperature of down to -20°F, and shall be contained in an
insulated battery enclosure. Batteries shall be Gould AP105 or approved
equal.

5. Disconnect.....A disconnect shall be provided to disconnect all
current-carrying conductors of the photovoltaic power source from all
other conductors in the gage house. Disconnect shall be Solavolt MSVS01
or approved equal.

6. Wiring.....All wiring required for the system from the modules to the
power load (RTU) shall be sized and supplied by the solar photovoltaic
supplier.

G. Gage House Level Measurement.....Level measurement of water in stilling
wells shall be accomplished using submersible transducers and remote
transmitters. Transducers shall be supplied with the length of cable
required for the particular gage house. Transmitter and transducer
shall operate over a pressure range of 0-150" and shall have a 4-20 mA DC
output. Power required shall be 24 VDC. Transmitter shall have the
special range calibration switch for the specific span of the particular
gage house and zero and span adjustments. Transmitter and transducer
shall be Viatran 514-5-CP-2-DH or approved equal.

H. Intrusion Alarm System.....Provide systems consisting of wide gap magnetic contacts and alarm processing centers. Systems shall detect when door is opened and after either a 5, 15, or 30 minute delay, shall close a dry contact to send alarm signal to the Main Control Panel. No audible alarm shall operate at the protected site. During the delay time, alarm may be reset for subsequent operation. Panel shall provide battery backup for 48 hours following utility power interruption. The magnetic contacts shall permit normal operating gaps of 2" between switch and magnet without loss of liability. Construction shall be Lexan. Systems shall be UL listed and manufactured by Ademco or approved equal.

I. Static Pressure Transmitter.....The pressure transmitter shall have a pressure range of 100 psi gauge for water depth of 200'. The transmitter temperature range shall be 40°F to 100°F. The transmitter shall have zero and span adjustments, combined non-linearity and hysteresis of +0.1% B.S.L., and a maximum temperature effect of +0.5%. Connections shall be 1/2" pressure connection and one pair shielded twisted pair for 24VDC power supply and 4-20mADC output. Transmitter shall be Druck type PTX110 or Owner approved equal.

2.8 OPERATOR WORK STATION

The furniture to be provided for work station shall conform to the Specifications listed below. The furniture shall be constructed of high grade materials with a suitable finish. Workmanship, materials, and construction details shall be in conformity with the best practices of the industry.

A. Data Terminal Desk.....Data terminal desk shall be a static-, scratch-resistant neutral light laminate work surface with integral equipment cabinets. Equipment cabinets shall be provided as indicated on the Drawings. Each equipment cabinet shall be mechanically ventilated to adequately dissipate heat per equipment manufacturer's recommendations. All equipment with the exception of operator interface peripherals shall be installed in the equipment cabinets. Equipment cabinets shall be as manufactured by Stantron, or Owner approved equal.

B. Operational Chair.....Operational chair shall be the swivel type with a four-star base and casters. The chair shall be provided with armrests. Upholstery shall be fabric-reinforced expanded vinyl. Seat and back shall be injection-molded and textured high-impact polystyrene. Base shall be die-cast of aluminum alloy with a cold-rolled steel tubing column. Chair shall be as manufactured by Herman Miller, Inc. or an Owner approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

Following completion of the factory acceptance test, systems shall be shipped to the job site and installed by the supplier.
A. Central Control System

Installation of the central control system shall include but not necessarily be limited to setting equipment in place and connection of power, communications, and interconnection wiring. All interconnection cables for the central system peripheral devices shall be furnished and installed by the system supplier. Power wiring shall consist of installing and connection 240 vac circuits from the building power supply. Communications wiring shall be coaxial cables installed from the central equipment cabinet to the radio system antenna.

The manufacturer shall provide the assistance and supervision by factory trained engineers for the purpose of advising and supervising the installation of the central control system.

B. RTU Panel Construction and Installation

Panels and enclosures shall be completely integrated communications, instrument, control, indication, and alarm panels. The panels shall be completely previred. Main groups of wire shall be routed in plastic nonflammable wiring duct. Smaller groups of wires shall be secured with nylon cable clamps and ties or plastic spiral wraps. Terminal blocks shall be used for all external wiring connections.

Equipment connections shall be made with spade lugs except where devices specified are available only with solder type terminals. Connections shall be made as recommended by the manufacturer.

The complete installation shall be done such that all instrumentation, control devices, panel instruments, etc. are completely accessible without major dismantling of panel equipment.

All control panels shall be front access only.

Nameplates shall be attached to panels with screws.

No control devices, or panel instruments shall be mounted on the enclosure doors. All control devices, i.e. pushbuttons, selector switches, indicators, shall be mounted on the front swing-out panel.

1. Installation....The control panels shall be installed at the locations shown on the Drawings. All panels shall be set plumb and level. After all field connections have been completed, close all openings to prevent debris from entering the panels. Field connections of power and control wiring shall be made through terminal blocks.

3.2 START-UP

No form of energy shall be applied to any part of the supervisory control and data acquisition system prior to the receipt by the Owner of a certified statement of approval of the installation from the Contractor containing the system supplier's authorization for applying energy to the system. The system supplier shall provide system start-up assistance by factory based engineering and programming personnel.
3.3 TESTING

A. General
The services of an authorized service representative of the instrumentation and control system supplier shall be provided to conduct all testing and calibration as specified herein. The service representative shall furnish all test equipment required for testing.

Testing reports showing dates, personnel making test, equipment or material tested, test performed, and results shall be maintained and delivered to the Owner upon completion of the testing.

Tests shall be conducted in the presence of the Owner, and field tests shall be supervised by the equipment manufacturer's field engineer. The Owner shall be notified one week prior to the commencement of all tests. The Contractor shall perform all tests recommended by the equipment manufacturer to determine that equipment, materials and systems meet all the requirements of the Contract Documents. The Contractor shall be responsible for any damage to equipment or materials caused by improper test procedures or test apparatus handling.

B. Factory System Operational Tests
After the system is assembled and debugged at the manufacturer's facility, a system test shall be performed before the system is shipped to the job site. The manufacturer shall prepare an integrated system test procedure, to be approved by the Owner, which shall demonstrate conformance of the system to the Contract Documents. The test shall be witnessed by the Owner. The Contractor shall include in the base bid the cost of airfare and lodging for up to two (2) representatives of the Owner to witness the successful completion of the factory system operational tests. Any subsequent visits required due to unsuccessful execution of the factory test shall be provided for by Contractor under the conditions stated above.

The supervisory control and data acquisition system shall have tests, simulating the actual field system conditions, conducted at the manufacturer's facility. Each major system component including the central computer system and peripheral devices, RTU's and all communications interface equipment shall be tested as specified.

Input variables shall be simulated at the RTU using 4-20mADC signal generators. Contact closure inputs shall simulate alarm and status events. During the course of the test, the simulated variables shall be processed for CRT graphics, reports, logs, and historical data accumulation.

Each analog variable input throughout the system shall be tested for system accuracy from input point to each operator interface device.

Central computer software tests shall include running of all diagnostics, all debugging routines, and all system test routines. The operating system, advanced process control language compiler, and all associated drivers shall be fully tested and operable for the system test.

All communication interface equipment between the central system and
RTU's shall be tested. The system test configuration shall simulate the
communication links of the central system and the remote sites which
will be accomplished via radio communications in the field.

C. Field Testing.....After each RTU, and the central system has been
installed, complete operational test of all instrumentation loops,
control loops, and communications channels as hereinafter specified
shall be conducted.

With each of the process variable transmitters (i.e., flow transmitter,
level transmitter, etc.) disconnected from the RTU, an adjustable signal
source shall be applied to the instrumentation loops, and span and zero
calibration shall be made on all analog input cards. The A/D conversion
of analog inputs shall be verified by comparing the signal source input
value with the data value output at the operator station. The A/D
conversion shall be checked at zero input value, 60% input value, and
full scale input value.

All remote control of valves, standby power and support systems shall be
tested by initiating the control functions from each central operator
station. The control functions shall be tested under both normal and
emergency power conditions. Valves not permitted to be operated shall
have the associated operator control disconnected from the RTU and the
controlling contact closure output shall be monitored for the
appropriate operation upon a remote control command.

All system alarm and status points shall be checked, all relays,
pressure switches, limit switches, and other system components that
cannot be operated in a normal manner with the system not in service
shall be checked by hand operation. These devices shall be rechecked
for proper operation with all systems in operation.

3.4 TRAINING

A. System Theory.....The control system manufacturer shall conduct a
two-day familiarization course to acquaint plant management personnel
with the operating principles of the system. This course shall be
conducted at a facility provided by the Owner. The course shall include
training necessary to add or delete points from the system, modify
tables and logs, modify and edit the maintenance program, rescale analog
points and lab data, and perform simple system diagnostics.

B. Computer System Training.....During the initial 5 days of operation, the
equipment manufacturer shall conduct an on-the-job training course for
the plant personnel. This course shall be designed to train the
operating personnel to operate the system including the following tasks:

1. Power up all equipment at the central control system.

2. Make all necessary routine checks when equipment is started.

3. Load any required executable program modules into the processor.

4. Interpret all diagnostic communications from the processor.
5. Take appropriate action for all alarm halt, error request, and interrupt conditions.

3.5 MAINTENANCE

The manufacturer shall include maintenance for a period of one year from the date of acceptance. This maintenance shall include a program of visits once every three months by a factory trained service engineer to perform periodic preventive maintenance work. Demand maintenance as required by the system shall also be included and shall be provided within 24 hours of request on a five-day week, eight hours per day basis. A subsequent maintenance contract may be entered into at the Owner's discretion following the one year warranty period.

Demand maintenance on software problems shall be handled via a telephone dial-up system.

3.6 SYSTEMS ACCEPTANCE

System acceptance shall be defined as the point in time when the complete system has passed the mutually defined field acceptance test and has performed as a functioning unit for 14 consecutive days without the loss of process control functions or process management functions. Loss of process control functions shall be defined as follows:

A. Loss of 50% or more of the capacity of any remote terminal unit or operator station for more than 8 hours.

B. Loss of disk subsystem for more than 8 hours.

C. Loss of scanning, alarm, and control functions.

D. Less than 98% system availability.

End of Section