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LEVEL II FEASIBILITY STUDY
IRON CREEK PROJECT
SHOSHONE IRRIGATION DISTRICT
AND THE WYOMING WATER DEVELOPMENT COMMISSION

HARZA ENGINEERING COMPANY ENGLEWOOD, COLORADO
in association with
SIMONS, LI & ASSOCIATES, INC.
FORT COLLINS, COLORADO
WRIGHT WATER ENGINEERS, INC.
CHEYENNE, WYOMING

AUGUST 1982
COVER PHOTO: Gotvand Irrigation Project
Karun River
Iran, 1977
Harza Engineering Company International

CLIENT: Khuzestan Water and Power Authority
Diversion dam for 100,000 acre irrigation system, including 180 miles of primary canals and laterals and 120 miles of surface drains.

SERVICES: Appraisal, feasibility studies, design, contract documents, and surveillance of construction.
August 5, 1982

Department of Administration and
Fiscal Control
Purchasing and Property Control Division
Emerson Building, Room 301
Cheyenne, Wyoming

Subject: Request for Proposal No. 042-N
Iron Creek Level II Feasibility Study
Shoshone Irrigation District and the
Wyoming Water Development Commission

Gentlemen:

Harza Engineering Company in association with Wright Water
Engineers and Simons, Li & Associates, Inc., is pleased to submit 21 copies of our proposal to provide professional engineering services for the Iron Creek Project. We are grateful for being pre-qualified as a finalist for this project. As required by the Request for Proposal, we plan to compare costs for repair of Corbett Dam and Tunnel with costs for constructing the proposed Iron Creek Project and perform an in-depth study of the more promising alternative. Details of our proposed staffing, qualifications, work program and costs are discussed in the attached proposal and summarized below. We are confident that our proposal fulfills the objectives and needs of the District, Commission, and the Legislature.

I. Qualifications & Staffing

The project team is qualified and capable in all technical areas and experienced in Wyoming water resource development, water law and rights, and standard western engineering practices. Our proposed Project Sponsor and Project Manager are Wyoming registered professional engineers. Together, they have nearly 40 years' experience with feasibility studies for diversion and hydro power projects. Work will be coordinated from Harza's Denver office. Harza will be the prime engineering contractor with Simons, Li & Associates responsible for environmental and hydrologic tasks and Wright Water Engineers responsible for water rights issues. To date, more than 100 dams have been constructed to Harza designs. Many of these projects have been diversion structures, hydro power dams, or both. The Gotvand Diversion Dam pictured on the cover of this proposal is an example of a recent Harza project similar to the proposed Iron Creek Dam in many ways. Harza's experience on these types of assignments includes prefeasibility, feasibility, design and construction management.
II. Work Program

The work program attached outlines our approach to the Iron Creek Study. We have inspected the Corbett Dam and tunnel headworks, as well as the proposed Iron Creek damsite. We are confident that we understand the requirements of the job and can provide the highest quality service.

A two-phase study is planned. Phase I concerns review of Corbett Dam and Tunnel. The decision to rehabilitate or abandon the tunnel is a serious one. Ultimately, the District will bear the financial responsibility for fixing the existing facilities or abandoning the tunnel and building Iron Creek Project. Our concept is to commit an emminently qualified team of hydraulic, sedimentation, concrete, and tunnel engineering specialists to quickly evaluate the structural and hydraulics problems, look at the operation of the tunnel, and recommend alternatives and costs to rehabilitate or replace the tunnel and diversion dam. Phase I concludes with a cost comparison of Corbett Dam and tunnel rehabilitation versus the Iron Creek Project. Assuming a notice to proceed by September 1, 1982, we are prepared to immediately commence work and provide an Interim Report to you by December 1, 1982. The report will summarize our Phase I findings, cost comparisons, and recommendations which will form the basis for decisions and the course of study continuation.

Phase II will formulate project concepts, look at alternatives, and result in a feasibility study of the Iron Creek Project. We have outlined an efficient work program which, assuming timely decisions, could produce a Final Report by July 31, 1983, thereby shortening the schedule 3 months. Our approach to Phase II is to follow basics. We have committed a team of experienced geotechnical, planning, hydro-power, and cost engineers to this effort. We have emphasized areas of particular concern, such as spillway sizing, type of dam, hydropower production, and more. For example, we propose to evaluate a roller compacted concrete dam alternative. Harza is in the forefront in this innovative technique with experience on two completed projects. Harza and hydro are synonymous. Hydropower production will be optimized in an effort to provide the maximum level of income to reduce the costs of building Iron Creek to the District. However, the primary purpose of Iron Creek -- as a diversion structure -- will be paramount in our feasibility study. We are emminently qualified and experienced in irrigation diversion structures.

III. Costs

The Iron Creek Study is ambitious, requiring many subtasks and field studies to compile necessary information on which feasibility will be determined. The following table summarizes our estimate of costs to complete the work program. A detailed task - cost breakdown is presented in the proposal.
IV. Closure

Harza, and our associate firm have an experience, reputation, and tradition which should be weighted in your evaluation. The record shows that we carry a high percentage of projects through feasibility to design and construction management. Most important, however, are our people. We have committed a highly experienced and motivated team of long-service engineers to your project. We affirm our commitment to provide the highest level of professional services on your project. We look forward to contract negotiations and your notice to proceed.

Very truly yours,

Dwight L. Glasscock
Vice President
A. Compensation

For the consulting engineering services covered by the accompanying proposal letter, Harza Engineering Company shall be paid monthly the sum of:

1. Salary Costs, plus
2. Overhead Costs and Fee, computed at 85% of Salary Costs, plus
3. Direct Costs

B. Definitions

1. Salary Costs - Actual direct salary payments to all personnel, including officers, engineers, designers, supervisors, draftsmen, other technical personnel, word processors, and other personnel for the time directly engaged on the work; plus payroll charges including vacation, sick leave, and holiday pay, unemployment and payroll taxes, social security contributions, workmen's compensation insurance, retirement benefits, medical insurance and group insurance benefits. Charges for payroll items for 1982 will be computed at 39% of direct salary payments.

2. (a) Overhead Costs - Costs which cannot be allocated to specific projects; examples are general administrative payroll, general stenographic and clerical payroll, rent of office and drafting room space, utilities, depreciation of office equipment, cost of maintaining customary liability and property insurance, etc.

(b) Fee - Payment to the Company for interest on invested capital, readiness to serve and profit.

3. Direct Costs - Costs which are directly applicable to the work such as transportation and subsistence expenses on travel in the interest of the work, long distance telephone, telegraph and telex expenses, reproductions, special insurance, Harza (in-house) and outside electronic computer rental costs, usage of computer programs, model and laboratory testing, aerial and ground surveying and subsurface exploration. When the costs of model and laboratory testing, aerial and ground surveying, subsurface exploration, and outside electronic computer rental costs are not paid directly to the laboratory, contractor, or supplier by the Client, an addition of 10% will be made to cover handling and financing costs.
LEVEL II FEASIBILITY STUDY
IRON CREEK PROJECT

Table of Contents

I. INTRODUCTION
   Transmittal Letter

II. QUALIFICATIONS
   A. General and Staff Qualifications
   B. Areas of Specialization
   C. Knowledge of Wyoming Water Law and Water Rights
   D. Previous Experience with Similar Projects
   E. Experience in Wyoming
   F. Rocky Mountain Regional Experience
   G. Staff Commitment/Wyoming P.E. Certification
   H. Project Management and Proposed Subcontractors
   I. Familiarity with Project Area
   J. References
   K. Bank References and Credit Rating
   L. Conflicts of Interest

III. WORK PROGRAM
   A. Work Outline
   B. Project Schedule
   C. Cost Estimate
   D. Total Price for Performance of the Entire Project
   E. Draft Contract

ATTACHMENT A.
   Compliance With General Conditions

ATTACHMENT B.
   Resumes

ATTACHMENT C.
   Harza News - '81 Annual Review
II.A General Qualifications & Staff Qualifications

Harza Engineering Company is a firm which provides consulting engineering services for the development of land, water, and power resources. Founded in 1920, Harza currently employs a professional staff of engineers and scientists numbering over 500. The firm specializes in dam and hydropower development, providing services throughout the U.S. and the world. Harza provides complete engineering services including planning, design, and construction management. Our service network includes a principal office in Chicago and branch offices in six other U.S. cities, including Denver.

We propose a well experienced team of engineers for the Iron Creek Project. The following Project Organization Chart and Project Staff Qualifications table reveal the principal project management and engineering staff personnel and their qualifications for the Iron Creek Project. Complete resumes are included in Appendix B.
TUNNEL AND DAM REHAB. ANALYSIS
- Lead Engineer: D. Baier
- Hydraulic Engineer: Dr. W.S. Hamilton
- Sedimentation: Dr. D. Simons
- Concrete Engineer: G. Mass
- Tunnelling Engineer: T. Martin

GEOTECHNICAL INVESTIGATIONS
- Lead Engineer: D.R. Baier
- Project Geologist: R.A. Paige

HYDROLOGIC INVESTIGATIONS
- Lead Engineer: Dr. T. Ballesteros

WATER RIGHTS ANALYSIS
- Lead Engineer: F.J. Trelease, III

PROJECT PLANNING AND HYDROPOWER
- Lead Engineer: D.H. McCandless

ENVIRONMENTAL BACKGROUND
- Lead Engineer: Dr. K. Eggert

COST ESTIMATES
- Lead Engineer: L.F. Levy

** Wright Water Engineers, Inc., Cheyenne, Wy.
### Iron Creek Project
#### Project Staff Qualifications

<table>
<thead>
<tr>
<th>Project Responsibility</th>
<th>Name</th>
<th>Years Experience</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Sponsor</td>
<td>J.C. Jones</td>
<td>26</td>
<td>Vice President and Head, Land Resources Department. Wyoming P.E. # 2523. Principal experience in geotechnical engineering, dam inspection and rehabilitation work.</td>
</tr>
<tr>
<td>Project Manager</td>
<td>W.A. Rettberg</td>
<td>11</td>
<td>Manager, Denver office, Wyoming PLE. # 3009. Principal experience in geotechnical engineering, particularly embankment dam design and construction. Project Manager and/or engineer on 10 tailings dams, 5 water supply projects, 2 hydropower projects, 3 mine planning projects, and 5 special projects.</td>
</tr>
<tr>
<td>Project Engineer</td>
<td>D.R. Baier</td>
<td>7</td>
<td>Geotechnical Engineer, Special Projects Section. P.E. Wisconsin. Principal experience in geotechnical engineering, emphasizing dam inspection and rehabilitation. Project engineer on $20.0 million rehabilitation of Lock &amp; Dam No. 1, Mississippi River. Currently Project engineer on 2 dam rehab studies in Colorado.</td>
</tr>
</tbody>
</table>
**Iron Creek Project**  
**Project Staff Qualifications**

<table>
<thead>
<tr>
<th>Project Responsibility</th>
<th>Name</th>
<th>Years</th>
<th>Experience</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Engineer</td>
<td>Dr. T. Ballestero</td>
<td>-</td>
<td>4</td>
<td>Senior Hydrologist, Simons, Li &amp; Associates, Inc. Manager, Cheyenne Office, Group Leader of SLA's water supply and environmental quality group. Dr. Ballestero experience includes water supply, hydropower, flood control water quality, and sedimentation studies.</td>
</tr>
<tr>
<td>Project Engineer-</td>
<td>D.H. McCandless</td>
<td>4</td>
<td>6</td>
<td>Senior Civil Engineer. P.E. Pennsylvania. Principal experience in water and power planning projects. Experience includes 8 hydro projects, 6 flood control and 4 water supply projects. He is currently lead planning engineer for a hydro expansion project near Twin Falls, Idaho and has prepared a FERC license application for a hydro addition at the Strontia Springs Project near Denver.</td>
</tr>
<tr>
<td>Planning &amp; Hydropower</td>
<td>F.J. Trelease</td>
<td>-</td>
<td>21</td>
<td>Vice President, Wright Water Engineers, Inc. Cheyenne, Wyo. Wyoming P.E. Extensive experience in water resource planning, particularly in water supply evaluation under water rights appropriation system.</td>
</tr>
</tbody>
</table>
### Iron Creek Project  
#### Project Staff Qualifications

<table>
<thead>
<tr>
<th>Project Responsibility</th>
<th>Name</th>
<th>Years Experience</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Scientist</td>
<td>Dr. K. Eggert</td>
<td>2</td>
<td>Director of Energy Related Projects, Simons, Li, &amp; Associates. P.E. Colorado. Experience includes permitting studies related to energy development projects in the western U.S.</td>
</tr>
<tr>
<td>Project Engineer</td>
<td>L.F. Levy</td>
<td>2</td>
<td>Head, Estimating and Scheduling Section. Extensive experience in cost estimating including hydro projects, transportation, water supply, dams, and navigation projects.</td>
</tr>
<tr>
<td>Project Responsibility</td>
<td>Name</td>
<td>Experience</td>
<td>Qualifications</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Project Engineer</td>
<td>Dr. D.B. Simons</td>
<td>30</td>
<td>Lead Hydrologist/Sediment analyst. P.E., Wyoming. Dr. Simons is a recognized authority and consultant in the design of channel diversion work considering sediment intake problems.</td>
</tr>
<tr>
<td>Project Geologist</td>
<td>R.A. Paige</td>
<td>11 14</td>
<td>Senior Geologist. Certified Engineering Geologist - California. Regional geologist with extensive experience in all types of geologic investigations including project construction. Experience includes 5 hydro projects, 4 pumped-storage project, 2 concrete arch dams, and 1 high rockfill dam.</td>
</tr>
<tr>
<td>Concrete Engineer</td>
<td>G.R. Mass</td>
<td>8 10</td>
<td>Senior Concrete Engineer, P.E. Calif., Oregon, Washington. As Harza's concrete specialist, Mr. Mass is involved in concrete materials, specifications, and inspection at projects throughout the U.S. He is also responsible for investigation and repair of concrete in existing structures, as well as an expert on roller compacted concrete.</td>
</tr>
</tbody>
</table>
II.B. Area of Specialization

The Iron Creek Project combines areas of specialty services which have been the fabric of Harza's business for over 62 years...

Land Resource Development

Harza is one of the few U.S. firms remaining active in large scale agricultural development, principally irrigation. We understand the irrigation business. Since 1960, Harza has engineering more than 50 irrigation projects. In 1981, alone, the firm had 11 projects involving water conveyance, rehabilitation, drainage, modernization, automation, dam design and raising, new lands development, and environmental assessments. These projects are highlighted beginning on p.13 of our '81 Annual Review in Appendix C.

Dam Engineering - Harza enjoys worldwide recognition as a leader in the field of dam engineering. Our experience record includes design and construction management of more than 80 earth and rockfill dams, 18 concrete dams -- gravity, arch, buttress, and combined arch -- gravity. Many of these dams have been engineered on foundation conditions similar to the Iron Creek Project. Interestingly, Harza is in the forefront on roller compacted concrete "rollcrete", completing design and construction management on two projects. We propose investigating the feasibility of rollcrete at Iron Creek.

Spillways - Hydraulic engineering is a tradition at Harza. The firm has designed, model tested, and constructed spillways of all types and capacity, among the world's largest. The spillway design for the Iron Creek Project would likely employ a conventional gated concrete spillway used on numerous Harza projects.

Tunnels - Harza has extensive experience in tunnels and underground engineering, particular water conveyance tunnels. We are the prime engineer for the largest tunnelling project (TARP Project, p.12, '81 Annual Review) in the U.S. involving bored tunnels up to 35 feet in diameter. In addition, Harza recently completed engineering and hydraulic analysis of 2 miles of water conveyance tunnel in Chile, a project very similar in many respects to Corbett Tunnel.

Hydropower - Hydropower is another primarily service offered by Harza. Harza engineers all sizes of hydro plants. Harza engineered the Strawberry Creek Project in Lincoln County, Wyoming back in 1950 for the Lower Valley Power & Light Co. Strawberry Creek provides 1,500 Kw of power and is still in services 31 years later. We are currently also engineering small hydro plants in Colorado and Washington. In Washington Harza is providing planning, licensing, design, and construction management services for 7 small hydro projects ranging from 1.0 MW to 44.0 MW for the South Columbia River Irrigation District (refer p.3 '81 Annual Review). We believe Harza is doing a significant share of small hydro work in the northeast and northwest of the U.S.
II.C. Knowledge of Wyoming Water Law and Water Rights

The water law/rights work will be subcontracted to the Cheyenne office of Wright Water Engineers.

Wright Water Engineers has been involved with Wyoming water right matters over its entire 21 year history. Of specific interest in this project; however, is the extensive experience of the Cheyenne Office personnel who have been consulting in water rights and water supply engineering in Wyoming for the past five years. This experience, coupled with experience gained while State employees, uniquely qualified Wright Water Engineers in not only the technical aspects of Wyoming's water law, but also operational analyses under Wyoming's specific requirements. The qualifications and experience of Mr. Frank Trelease and Mr. Phil Lehr of Wright Water Engineers have been referenced. Resumes are included in Appendix B.

II.D. Previous Experience with Similar Projects

Harza has extensive experience in all components of the Iron Creek Project. In fact, Iron Creek combines the usual complement of services utilized on most of our projects. The Gotvand Project depicted on the proposal cover is a prime example of a project similar to Iron Creek. Other examples of rehab projects are the Rehabilitation of Huron River Dams and the New York City Dams Inspection depicted on the attached project fact sheets. Small hydro is an active program at Harza. The current work for South Columbia Basin Irrigation District in Washington is an example. Yet the Iron Creek Project presents some unique conditions and problems to be solved. Our greatest contribution is our experience from similar projects which will accrue to the District; resulting in sound engineering.
Rehabilitation of Huron River Dams, 1971

Client
City of Ann Arbor, Michigan

Location
Huron River, Michigan

Barton Dam (shown here) and the Superior, Argo and Geddes Dams were built about 70 years ago. Harza was retained to inspect the dams, make recommendations for repairs, prepare plans, and provide resident engineering services during reconstruction work. The height of structures varies between 20 and 35 feet (6.1 and 10.7 m). Reconstruction work included replacement of one spillway, enlargement of another, removal of two old powerhouses and installation of modern tainter gates with automatic controls in all four dams. Total reconstruction cost was $1.9 million.
South Columbia: An Irrigation System Becomes an Economical Power Project

Five Developments to Provide Energy During Irrigation Season

Harza Engineering Company, in a joint venture with Schuchart and Associates, Inc. Seattle, WA, is developing hydropower for the South Columbia Basin Irrigation District in eastern Washington. The project consists of five individual developments, each on reservoirs or canal drops of the Columbia Basin Project, an irrigation system. This type of project is economically attractive because of the higher cost of alternative forms of energy.

The project will develop energy that is available in the irrigation canals for use during the March through October irrigation season. The plants will run on irrigation demand during these months.

Harza's involvement in the project began in June, 1981 by reviewing the feasibility of the five projects:
- EBC (Eltopia Branch Canal) 4.6
- PEC (Potholes East Canal) 66.0
- PEC (Potholes East Canal) Headworks
- Main Canal Headworks
- Summer Falls

Power Purchased and Sold

Three irrigation districts are cooperating in the project and own the power plants. They are: the East Columbia Basin Irrigation District, the Quincy Columbia Basin Irrigation District, and the South Columbia Basin Irrigation District, which is the lead district.

The project is financed by the sale of South Columbia Basin Irrigation District Hydroelectric Revenue Bonds, issued by the South Columbia Basin Irrigation District. A power purchase and sale contract has been entered into between the cities of Tacoma and Seattle. The Districts have agreed to sell to each of the cities 50 percent of the output from each development.

Summer Falls to Generate 94 MW

Summer Falls is the largest and most important project, consisting of two units to generate 94 MW with a head of 160 feet. The project is adjacent to the Summer Falls State Park approximately eight miles south of Coulee City, Washington.

Summer Falls is a man-made waterfall. The irrigation water flows down a series of rapids and over a natural basalt precipice, forming the falls, which discharge into Billy Clapp Lake. During the non-growing season, the canal system is dewatered and Summer Falls dries up, while a water level is maintained in Billy Clapp Lake.

Construction was underway in early 1982 for powerhouse excavation and cofferdam construction. The next phase will be the provision of caissons for powerhouse support. The final phase will be the construction of all other civil works: powerhouse, intake structures and tunnels.

2.4 MW Hydro Construction Underway at EBC 4.6

Construction was underway in early 1982 on the EBC (Eltopia Branch Canal) 4.6 project, a 2.4 MW hydroelectric plant with head of 127 feet. It is adjacent to the check structure at milepost 4.6 on the Eltopia Branch Canal.
The plant will consist of an intake canal, intake structure, penstock, powerhouse, tailrace, switchyard and related facilities.

Project location is approximately 18 miles north of Pasco and four miles northeast of Eltopia, Washington.

PEC 66.0 Scheduled On-Line For 1982

The PEC (Potholes East Canal) 66.0 project will have a 2.6 MW hydroelectric plant with head of 325 feet adjacent to the check structure at milepost 66.0 on the Potholes East Canal. Construction is expected to be completed by fall, 1982. The plant will consist of an intake structure, penstock, powerhouse, tailrace, switchyard and related facilities. The existing gate in the check structure will provide spill capacity during both plant operation and shutdown.

Geotechnical Work on PEC Headworks

Harza services for PEC (Potholes East Canal) Headworks at O'Sullivan Dam include the review of the feasibility report and geotechnical exploration. Started in July, 1981, the proposed project would be the addition of a hydroelectric power plant at the existing dam and irrigation canal.

Headworks Reservoir Serves Two Functions

The Main Canal Headworks is located at Dry Falls Dam, which impounds the south end of Banks Lake. The 27-mile long reservoir (Banks Lake) is the headworks for the proposed power plant which serves as an equalizing reservoir for storage of irrigation water. It will ultimately be utilized as a source of water for pumped-storage and power generation at Grand Coulee Dam. Head range available at the site is 30 ft to 54 ft.

Final studies to develop project arrangement were underway in early 1982. One or two bulb units with a total capacity of 22.8 MW will be installed. The average annual energy potential is approximately 80 GWh.

Completion of construction of the last Schuchart/Harza development is estimated to be 1985.

A 20. SCB1 582
Foothills Project To Ease Denver’s Water Problems

Award-Winning Dam Has Innovative Design Feature

The need to increase Denver’s water treatment plant capacity was emphasized after the water shortages experienced during the summer of 1973. The Denver Water Board (DWB) acted to implement a three-pronged plan, the Foothills Water Supply Project, to provide the area’s two million residents with an economical and abundant resource.

A major component in the plan is the Strontia Springs Dam on the South Platte River, designed by Harza.

The dam will provide water storage and sufficient hydraulic head to supply water through a 10.5 foot diameter tunnel to a water treatment plant three miles away.

Location A Plus

The project increases Denver’s potable water supply by 125 mgd to 645 mgd. It is located in Kassler, Colorado, 25 miles southwest of the city of Denver. An innovative aspect of the design is the location that will provide adequate head for a gravity fed supply system through the Denver metropolitan area which eliminates the need for extensive pumping.

Water Supply

Water from the reservoir for treatment will enter the Foothills tunnel through an intake tower located on the right abutment upstream of the dam. The tower will have four gated openings, each 7.5 feet wide by 15 feet high, located at successively lower levels to allow selective withdrawals from different reservoir depths.

A second intake tower, located 82 feet from the first and higher on the right bank, will serve the City of Aurora water system. It will be equipped with two slide gates operating under balanced head.

Dam Construction

Strontia Springs Diversion Dam is a double-curvature thin arch dam 292 feet high. It is 30 feet thick at the base and 10 feet thick at the crest, with a crest length of 650 feet.

The service and the auxiliary spillways will handle flows up to the design discharge of 90,000 cfs. The service spillway, located near the center of the dam, will handle discharges up to 12,000 cfs before the auxiliary spillway with an emergency fuseplug spillway is activated. The auxiliary spillway is located in the left abutment and consists of a short concrete chute which will, if needed, discharge well downstream of the dam. Outlet valves in the lower part of the dam will provide for downstream releases when the reservoir level is below the spillway crest.

The design of the dam is based on the results of two independent types of analysis: the complete trial load method, and the three-dimensional finite element method. Extensive geological and foundation exploration programs were implemented to assure a rock abutment which could safely carry the thrusts from the thin arch dam.

As the dam was constructed, instruments were installed at strategic locations to monitor concrete temperatures, contraction joint openings and monolith deflections. When the reservoir is filled, the instrumentation will be used to monitor the performance of the dam.

Upstream view of the 292 foot high Strontia Springs Dam. The diversion tunnel portal is at the left, and an intake tower will be constructed on the right.
Construction Management Services
Harza has a resident staff of 17 construction management specialists at Strontia Springs. Complete contract administration during construction includes:
- detailed project task review, cost control and coordination
- field quality control for all installed works: concrete, earth embankments, grouting, gates, intake/outlet works, electrical and mechanical works
- review of contractors’ submittals and shop drawings
- review of contractors’ monthly progress statements
- shop inspections of major mechanical/electrical equipment
- issue of change orders
- analysis, presentation to the owner, and resolutions of claims
- issue of weekly/monthly project progress reports
- computer aided project record preparation and retention including record drawings
- project completion reports

Environmental Considerations
Environmental issues were carefully considered in the design of the project. Minimum flows downstream of the dam will be maintained to upgrade the habitat for fish in that reach of the river. During construction, an extensive program was implemented to maintain the well-being of a herd of wild mountain sheep in the area.

Close-up view of two Strontia Springs workers lifting river outlet structure form for placement on the upstream face of the dam.

Strontia Springs Dam Highlights
Winner, Consulting Engineers Council of Colorado, Engineering Excellence Award, 1982, Large Projects. Winner, Rocky Mountain Section of American Concrete Institute (ACI) "Outstanding Engineering Achievement in the Use of Concrete" for 1982.
Estimated Completion Date: Summer 1982
Harza Personnel: Project Director, R.D. Harza; Project Manager, R.P. Wengler; Construction Management, D.J. Duck
DWD Contact: Jim A. Batt, Project Manager, Foothills Project/Strontia Springs Dam.
Engineering services for the Foothills Water Supply Project have been provided by:
Harza Engineering Company: Strontia Springs Diversion Dam
DMJM-Phillips, Reister, Inc.: Foothills Tunnel and access roads
CH2M-Hill: Foothills Treatment Plant
NEW YORK CITY WATER SUPPLY DAM INSPECTION
New York State

Oldest Portion of System to be Returned to Modern Operating Condition

Fourteen Dams, Three Controlled Lakes Under Study

New York City is reputed to have some of the best quality water of any large city. The primary reason for that enviable reputation is the extensive system of reservoirs and aqueducts that supply the 1.5 billion gallons of water used every day.

Over the years, expansion of the water system has paralleled the growth of the city, with the result that some of the structural elements are now more than one hundred years old. In 1980, the New York City Department of Environmental Protection, Bureau of Water Supply, retained Harza for a comprehensive examination of 14 water supply dams (see accompanying table) located in the older East of Hudson District of the system.

The three-year inspection and analysis program will identify work needed to put the facilities back in first class operating condition.

Thirteen of the dams are located in the Croton River watershed; the fourteenth, Kensico Dam, is a regulating reservoir receiving water from the Delaware and Catskill water supply systems. All of the dams are either masonry structures or earthfill structures with masonry corewalls.

The studies and related project reports are being developed in three phases. Phase A involves a review of available data and field inspections of each dam. Preliminary reports summarize the findings of this phase. Phase B field work includes aerial and field surveying, soil and masonry borings, concrete core drilling, underwater examinations, laboratory analyses, and gate valve examinations. Phase C will evaluate the results of the field investigations, modify the results of the Phase A reports as appropriate, and culminate in final reports on each dam with recommendations for rehabilitation.

Location of the 14 dams and three controlled lakes in the East of Hudson District.

New Croton masonry dam is 297 feet high and was constructed in 1905. The curved, stepped wall at left is the side-channel spillway.
A walk Dam, one of six earthfill dams with masonry corewalls included in the project, was constructed in 1897.

Amawalk Dam, one of six earthfill dams with masonry corewalls included in the project, was constructed in 1897.

Other basic studies included in the evaluations are:

**Hydrologic Studies**

Comprehensive hydrologic studies are based on available data where possible and include analyses using publicly available and Harza-developed computer programs. The principal areas of study are:

- review of available data and determination of hydrologic characteristics for each sub-basin
- determination of flood characteristics, including the probable maximum flood (PMF), the standard project flood (1/2PMF), and the 500, 100, 50, and 20 year floods.
- flood routing through the reservoirs and routing of a possible flood wave from an upstream dam break
- determination of present spillway capacities and methods of increasing capacities where needed
- determination of maximum water surfaces, including flood inundation mapping and the potential for downstream loss of life
- investigation of reservoir operations as a network system

**Hydraulic Studies**

Hydraulic studies concern both the safety and efficiency of reservoir operation. Principal study elements are:

- determination of spillway capacities and the possible effects of the dams being overtopped by major floods
- investigation of the capacities and condition of inlet and outlet works
- studies of the feasibility of adding hydroelectric generation at each of the dams

**Structural Stability**

Assurance of the stability of the dams requires a variety of studies which could, if the initial findings so indicate, be carried out in more detail in a subsequent phase. Initially the work includes:

- seismicity studies based on a review of seismic history and determination of the appropriate design earthquake for the area
- investigation of foundation and embankment seepage, slope stability, slope protection, the potential for liquefaction, and the possibility of extreme loading conditions occurring simultaneously
- stability analyses of all concrete dams and appurtenant structures to determine resistance to overturning, sliding, and overstressing under a variety of conditions

Modernization of the System

In addition to preparing recommendations for needed rehabilitation, Harza is studying methods of modernizing the system management practices and techniques. These studies are particularly directed at: 1) information collection and integration, 2) instrumentation, telemetry, and remote control and 3) the physical security of the dams.

Two New York engineering firms are assisting Harza with this project through subcontract arrangements. They are Parsons, Brinckerhoff, Quade & Douglas, Inc., and Feld, Kaminetzky & Cohen, P.C.

**Catskill Aqueduct**

In a related assignment, Harza personnel assisted with inspection of the portion of the Catskill Aqueduct connecting Kensico and Hillview reservoirs. Inspection of intake and outlet structures and typical sections of the 17-mile long cut-and-cover conduit were included in the assignment.

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**New York Dam Inspection**

**Date:** 1980–83

**Project Reports:** Preliminary reports on each of the fourteen dams containing findings from initial field investigations and data research. Final reports on each dam detailing needed rehabilitation, costs, and schedules.

**Harza Personnel:** Project executive, D.L. Glasscock; project manager, J.T. Passage; assistant project manager, J. McDonnell; lead engineers, R. Wong (geotechnical), N. Schickedanz (hydrology), and V. Norkus (mechanical) and D. Baer (geology).

**NYC Department of Environmental Protection contact:** Edward Scheader, Deputy Director of Water Supply. Associated with Harza on the project are Parsons, Brinckerhoff, Quade & Douglas, Inc., and Feld, Kaminetzky & Cohen, P.C., both of New York.
II.E. Wyoming Experience

Harza's Wyoming experience spans over a 37 years period of the firm's 62 years history. Project work has included: surface and groundwater studies, tailings dam planning, small hydro design, dam design and inspection, transmission engineering, mine planning and environmental studies and construction management. These projects comprise a cross-section of available services and capabilities, allowing a good working knowledge of Wyoming's vast resources: water, energy, and mineral, and the private, institutional and regulatory structures surrounding resource development. Furthermore, we have worked in 8 of Wyoming's 23 counties, including "Park County". To supplement our skills in specific areas, (e.g. water rights), eminently qualified subcontractors have been proposed.

A listing of relevant Wyoming projects, services performed, clients, and dates of services follows for your information and detailed review.
<table>
<thead>
<tr>
<th>PROJECT NAME AND DESCRIPTION</th>
<th>CLIENT NAME</th>
<th>PERIOD OF SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Resources Development Study near Buf­</td>
<td>Mobil Oil Corp; 01/81 - 06/81</td>
<td></td>
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<tr>
<td>talog, Wyoming. Provided services in the following:</td>
<td>Mining and Coal Division</td>
<td></td>
</tr>
<tr>
<td>surface water availability; water rights; potential storage projects;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>preliminary design and costs for diversion structures, dams and reservoirs, pumping plants, and pipelines; project permits and implementation schedule.</td>
<td></td>
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</tr>
<tr>
<td>Copper Mountain Uranium Mine Project. Provided a variety of technical services aimed at starting construction of the uranium mine and mill complex. Major services areas included: 1) geotechnical; 2) engineering geology and hydrogeology; 3) hydrology and water management and 4) assistance with data collection for permit application.</td>
<td>Rocky Mountain Energy Company</td>
<td>09/78 - 04/80</td>
</tr>
<tr>
<td>Caballo Mine and North Raw­</td>
<td>The Carter Mining Company</td>
<td>05/78 - 12/79</td>
</tr>
<tr>
<td>hide Mine Water Management Project. Developed a recommended plan of water-control facilities that ensures safe, efficient, and uninterrupted mining operations; collected and documented baseline hydrologic data; developed plans for monitoring the surface-water and groundwater regimes during mining and later restoration; and defined post project hydrologic regimes.</td>
<td></td>
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</tbody>
</table>
Strawberry and Swift Creek Project. Dam inspection and report on Strawberry Creek for expansion and on Swift Creek for rehabilitation.

115 and 230-kV Transmission Line Project, Laramie. Provided services to study and determine the in-place cost of single circuit 115-kV and 230-kV transmission lines. Major service areas included: 1) structure designs; 2) insulation requirements; 3) right-of-way requirement; 4) cost estimates; 5) estimation of in-place cost per mile of construction; 6) and recommendations for the type of construction and span length.

Powder River Storage Development Project, Powder River. Prepared a prefeasibility report concerning development of four storage reservoirs on the Powder River which will be used for the storage of municipal and industrial and agricultural water.

Strawberry Creek Project. Provided preliminary design, plans and specifications, and engineering services during construction for the Strawberry Creek dam, spillway and powerhouse.

Heart Mountain Relocation Center Project, Cody. Provided design.

Lower Valley Power and Light Company
Basin Electric Power Cooperative
State Engineer's Office, State of Wyoming
Lower Valley Power and Light Company
U.S. Army Corps of Engineers, Fort Peck District
II.F. Rocky Mountain Regional Experience

The nature of our business makes the Rocky Mountain states a principal market for our services. In addition to our Wyoming experience, Harza has current or completed projects in all the Rocky Mountain region states: Wyoming, Colorado, New Mexico, Idaho, Utah and Montana. To date, more than 50 major assignments have been completed ranging from small to large scale hydropower development; water supply dams, pipelines, pumping plants, and canals; electrical transmission engineering; regional water planning; fish hatcheries; dam inspection and rehabilitation; environmental studies; and mine planning and tailings dam projects. Importantly, our staff is thoroughly familiar with western engineering practices. For example, our staff includes top water experts trained at western universities and former U.S. Bureau of Reclamation specialists. The combination of vast Rocky Mountain project and staff experience will be of considerable value in engineering the Iron Creek Project.

II.G. Staff Commitment/Wyoming P.E. Certification

The proposed Project Sponsor, Mr. J. C. Jones, and Project Manager, Mr. W. A. Rettberg, for the Iron Creek Project are registered Wyoming Professional Engineers (nos. 2532 and 3009 respectively). Mr. Jones is a Vice President of the firm; Mr. Rettberg serves as Manager of the Denver Office. Harza hereby certified that any work performed on the Iron Creek Project by Harza or subcontractors will be under the direct control and supervision of these two individuals.

The Iron Creek Project organization chart show the proposed individuals, functional responsibilities, and organizational relationships. We faithfully represent that the proposed project staffing is experienced, capable, and available to serve on the Iron Creek Project subject to the approval by the Shoshone Irrigation District (S.I.D.) and the Wyoming Water Development Commission (W.W.D.C.). Individuals will not be reassigned without the prior consent of the S.I.D. and the W.W.D.C.

II.H. Project Management and Proposed Subcontractors

Project Management. The project team will be structured to provide single source accountability to the District and will assure coordinated and organized implementation of your project. The Project Manager is responsible and accountable for the overall execution of the work. He is responsible for accomplishing the tasks in the work plan, as well as receiving additional direction from the District. Internally, the Project
Manager is responsible for activities of the Lead Engineers with respect to work planning, scheduling, budgeting, and reporting. He will monitor the work plan in these respects and be accountable for performance, including "on-time" completion within budget limits.

Reporting to the Project Manager will be five Lead Engineers who will be responsible for their respective work plans, budgets, scheduling, and reporting for the various study. They will be held similarly accountable for these functions. The Lead Engineers will initiate and undertake work on specific tasks within their assigned responsibilities and be accountable to the Project Manager for the completion of those tasks.

To facilitate project management, Harza has put in place computer aided system within the past few years. The main element in the system is the Work Planning and Review form which permits weekly tracking of tasks completed and man-hours consumed. We will be pleased to explain this excellent management tool during contract and scoping discussions.

Subcontractors. Wright Water Engineers and the firm of Simons, Li & Associates, Inc. will provide subcontract technical assistance in water rights, hydrology, hydraulics, and environmental specialties. The extent of their participation is described in the accompanying work program. The qualifications of the firms, in general, and individuals, in particular, are stated where appropriate in this proposal. Subcontractors to provide surveying, mapping, drilling and testing are required, but not named in this proposal. We prefer to leave our options open at this time to allow for better negotiation of terms upon Harza's authorization to proceed. We have, however, contacted qualified field and laboratory services subcontractors to obtain estimates for work spelled out in this proposal.

The overall Project and subcontractors will be managed as shown on the following Management Plan. Any field or laboratory service subcontractors will be managed by Mr. Russell A. Paige Harza's Project Geologist in the Denver office.
HARZA LEAD ENGINEER
D.R. Baier

- Geotechnical
- Planning
- Underground Engineering
- Hydro
- Cost Estimating
- Hydraulics

SIMONS, LI & ASSOCIATES
LEAD ENGINEER
Dr. D.B. Simons

- Sedimentation
- Hydraulics
- Hydrology
- Environmental

WRIGHT WATER ENGINEERS
LEAD ENGINEER
F.J. Trelease, III

- Water Rights

SHOSHONE IRRIGATION DISTRICT

HARZA PROJECT MANAGER
W.A. Rettberg

HARZA PROJECT SPONSOR
J.C. Jones

IRON CREEK STAGE II FEASIBILITY STUDY
PROJECT MANAGEMENT PLAN

Harza Engineering Company  ●  August 1982
II.I.  Familiarity with Project Area

Harza Engineering has taken steps to acquire a sufficient knowledge of existing and proposed facilities, site geo-technical conditions, hydrologic information, and other relevant data to assure a responsive proposal. We have conducted a personal site visit and gathered background information from state and federal water and geologic resource agencies. We believe that our firm's vast experience and credibility in planning, design and construction of projects in similar geologic and hydrologic settings will rapidly overcome any initial site familiarity deficiencies. In addition, we have enlisted subcontractors with long standing experience throughout Wyoming. We believe our team is sufficiently prepared to begin project work without further site familiarization.

II.J.  References

We invite the District and the Commission to verify and confirm our professional record.

Mr. Jack Parsons
Poothills Project Manager
Denver Water Department
Denver, Colorado
303/623-2500

Mr. Lou Allen
Water Resource Engineer
Wyoming State Engineer's Office
307/777-7354

Mr. Les Bell
Manager of Engineering
Lower Valley Power & Light Co.
Afton, Wyoming
307/886-3175

Mr. Larry Simpson
Secretary - Manager
Northern Colorado Water Conservancy District
Loveland, Colorado
303/607-2437
II.K. **Bank References and Credit Rating**

**Bank References**

The Northern Trust Company
50 South La Salle Street
Chicago, Illinois 60690

First National Bank of Chicago
One First National Plaza
Chicago, Illinois 60606

**Credit Rating**

Harza has a rating of 3Al with Dun & Bradstreet; this is the highest credit rating on the rating scale established by that firm for companies of Harza's size. In our latest financial statements, the net assets of Harza Engineering Company were $9,100,000, and net assets of all the Harza companies totaled $22,200,000.

II.L. **Conflicts of Interest**

Harza Engineering Company has no current client relationships that conflict with the interest of the District or the Wyoming Water Development Commission pertaining to the Iron Creek Project. We have similarly verified that no conflicts of interest exist with any our proposed subcontractors.
Section III

WORK PROGRAM

Introduction

Harza has prepared its Work Proposal with the work divided into two phases.

Phase I includes a general review and comparison of the two general project alternatives:

1. Upgrading the existing Corbett Dam and tunnel.
2. Constructing a new, higher diversion dam at the Iron Creek site.

Hydroelectric power installations would be included for both alternatives. This first phase of the work includes Tasks A through C, Task O (the Interim Report), and possibly one meeting under Task Q (Public Meeting) as described in the Commission's statement of Specific Services.

Phase II of the studies is a feasibility study of the selected alternative. Our approach follows Tasks F through N, P, and Q of the statement of Specific Services, which are related to the feasibility of a new Iron Creek Diversion dam. Tasks D and E of the statement of Specific Services which relate to a detailed study of Corbett Dam have also been addressed in the proposal.

Our work plan is presented in the following pages, where each task is described in outline format. A bar-chart schedule for the work tasks and sub-tasks is then presented, followed by a cost estimate by task and for the total study program. Finally, a copy of a sample Harza contract for this type of work is attached.

Study Task Descriptions

Phase I - Review and Comparison of Alternatives

Task A - Critical Path System

Immediately after receiving notice to proceed for the Iron Creek studies, Harza will prepare a Critical Path System diagram, showing the work plan and schedule for the work. The diagram will show starting and ending points and duration of each activity; and interrelationship between activities, identifying work that must proceed sequentially and work that may
proceed concurrently. This draft Critical Path diagram will be reviewed and refined in consultation with the District prior to submission to the Commission, and will be revised and updated throughout the study period if warranted by changed conditions.

The Critical Path System diagram can be easily prepared by using the detailed activity and manpower scheduling information that is developed internally at Harza for management of all of our engineering projects.
Task B. Analysis of Existing Facilities

The principal item of work for this task is a detailed dam and tunnel inspection. The inspection will form the basis for development of preliminary cost estimates to be used for comparison with Iron Creek Dam cost estimates (see Task C below).

The prime questions to be answered by the work of this task are:

• How does the tunnel perform now?
• What can be done to improve performance?
• How can the structural deterioration be repaired?
• How much will the repairs cost?

The work will consist of the following subtasks:

1. Review existing data and previous reports - examine project drawings and design and construction records.
2. Visit dam and observe tunnel hydraulics; measure flow in tunnel at outlet.
3. Make a visual inspection of the existing dam and tunnel interior in accordance with ACI procedures (ACI 207R-79 and ACI 201.1 R-68).
4. Determine necessary tunnel rehabilitation work and select methods to be utilized.
5. Determine necessary dam rehabilitation work to repair gate seals on 4 ft x 5 ft sluice gates and other features which require upgrading.
6. Observe sedimentation patterns in reservoir and around tunnel intake.
8. Evaluate tunnel hydraulics under existing and rehabilitated conditions.
11. Prepare preliminary, comparative cost estimates for:

(a) Dam Repair
(b) New Sediment Trap or Diversion Structures
(c) Tunnel Repair
(d) Tunnel Abandonment
(e) New Tunnel Construction

The major emphasis will be placed on the tunnel work. Before any decision is made to abandon the Corbett Tunnel, we feel that a careful inspection of the tunnel should be made and that a preliminary hydraulic analysis of tunnel performance is warranted. Additional field inspection work is required. On his visit to the site in June, our Mr. Jim Trawinski observed the tunnel during operation and had the opportunity to discuss operations problems with District staff. Gravel in the tunnel and at the tunnel inlet has evidently been a major problem for many years. There appears to be the distinct possibility that the sediment problems and the means taken to divert sediment away from the intake may have resulted in tunnel hydraulics that have contributed to the reported structural deterioration in the tunnel. Poor entrance conditions may cause a hydraulic jump in the tunnel. These same conditions may also decrease tunnel flow capacity. Deterioration of the tunnel lining caused by gravel bra- sion may have increased tunnel roughness, thereby decreasing capacity.

The main work of this task is the detailed inspection of the tunnel and development of cost estimates. Key inspection personnel and their responsibilities are given below.

Dr. Wallis S. Hamilton - Senior Hydraulic Analyst; tunnel hydraulics studies and sedimentation. Dr. Hamilton will inspect the dam and the tunnel interior and will also make a visit to observe tunnel hydraulic performance before dewatering at the end of the irrigation season.

R. "Al" Paige - Lead Geologist; Harza Denver. Mr. Paige will be Lead Geologist for the entire project and will participate in the tunnel inspection to attempt correlating areas of distress with geologic information.
Dr. Daryl B. Simons - Lead Hydrologist/Sediment Analyst, Simons & Li Assoc., Inc. Dr. Simons will be responsible for evaluating sedimentation patterns around the tunnel intake and for assisting Dr. Hamilton in developing means to trap or divert troublesome gravel.

Mr. Gary R. Mass - Lead Harza Concrete Specialist. Mr. Mass will perform the detailed structural inspection of the tunnel interior. Initial inspection for this task will only include visual inspection, isolated hammer sounding and photography. Detailed crack mapping or nondestructive geophysical testing or sampling will be done under Task D, if warranted. Mr. Mass is a member of 6 ACI committees and chairman of ACI 207-Mass Concrete, the committee that publishes standards for condition surveys of concrete in service and is a corresponding member of ACI 210 - Erosion of Concrete in Hydraulic Structures. Mr. Mass will develop methods for tunnel restoration and prepare the cost estimates.

Mr. David R. Baier - Harza Chicago Coordinator and Dam Inspection Engineer. Mr. Baier has been involved in over 40 dam safety inspection projects during the past 7 years. Mr. Baier will participate in the Corbett inspections, visit the Iron Creek site, and coordinate report sections dealing with Corbett Dam and Tunnel.

Mr. Tom Martin - Harza Tunneling Specialist. Mr. Martin will be responsible for developing approximate costs for rehabilitation/ reconstruction of Corbett Tunnel. Mr. Martin has 20 years experience as an estimator for several large tunnel contractors including work as Project Manager for construction of 2.5 miles of 30 ft diameter tunnel and 1.5 miles of 13 ft diameter tunnel for Chicago's TARP project.

Detailed resumes for all the individuals identified above are included in Appendix B.

Review of existing data, observation of tunnel performance and dam inspection can begin immediately. We understand, however, that the tunnel cannot be dewatered until after 20 October. It is important to have access to the tunnel as close to this date as possible since the results of this task and the cost comparison described in Task C, below, are planned for inclusion in the interim report due December 1, 1982.
Task C. **Comparison of Costs**

1. Corbett Dam and Tunnel Alternative
   a. Upgrading procedures and costs developed in Task B, above, will be used.
   b. Hydroelectric installation concepts and costs will be reviewed and refined by Harza, at pre-feasibility level.

2. Iron Creek Diversion Dam Alternative
   a. Pre-feasibility level concepts and costs will be developed by Harza for the proposed dam, spillway, canal outlet, and low level outlet. We intend to utilize any information previously developed by the District and other consultants.
   b. Hydroelectric installation concepts and costs will be developed.

3. Hydroelectric Benefits
   a. Harza will obtain preliminary values for power and energy production through discussion with potential power purchasers.
   b. Harza will use flow-duration analysis, based on flows available under existing conditions (see Task I, below), to determine preliminary power and energy production for the alternative installations.

4. Comparison
   a. Projects will be compared on basis of net cost to the water consumer, i.e. the gross project costs will be reduced by power revenues.
   b. Results are expected to be presented in the Interim Report (Task Q) and the first Public Meeting (Task Q).
Task D. Repairs to Existing Facilities (Optional, for Corbett Dam and Tunnel)

Repairs to Corbett Dam and Tunnel will be investigated in detail if the results of cost comparisons described above for Task C show that rehabilitation of the dam and tunnel is the preferred alternative. The work of this task will be an outgrowth of Task B above.

Subtasks are as follows:

1. Evaluate spillway adequacy and prepare cost estimates and sketches for any improvements.

2. Estimate costs for gate rehabilitation. Seals have reportedly been damaged by gravel.

3. Develop cost estimates and prepare sketches for sediment trap or diversion structures.

4. Evaluate need for stability improvements and estimate costs therefor, if required.

5. Perform detailed inspection of tunnel; prepare condition survey drawings and crack maps; take core samples of concrete for laboratory investigation (ASTM C823). Use radar device to survey lining for voids, if such action seems warranted.

6. Prepare cost estimate and sketches for tunnel rehabilitation.

7. Prepare cost estimates and sketches for new Corbett Tunnel if this option is found to be economically feasible.

8. Collect data for report preparation described in Task E.
We have not estimated time and budget for this task because of the uncertainty in actual scope of work and decisions to be reached by the District and the W.W.D.C. It would appear that sufficient money and time would be available to complete Task D if Tasks G through I are deleted from the Work Plan.

Task E. Report and Termination of Study (Optional, for Corbett Dam and Tunnel)

1. If upgrading Corbett Dam proves to be the most attractive alternative (Task C, above), a feasibility report describing the proposed work, including any hydro installation, will be prepared.

2. The Commission will be provided an original and 150 copies of the report.

3. Results may be presented in the second Public Meeting (Task Q).

Task F. Alternative Work Outline

1. Based on results of the Cost Comparison in Task C, above, the Commission and the District (with the consultant's advice) will determine whether to proceed with Tasks D and E, above, or to proceed with studies of a new diversion as in Tasks G to N, below.

Task G. Surveying

1. Required Survey Information:

   In accordance with the Request-for-Proposal, field surveys are required to establish the following at the Iron Creek damsite:

   - Ties to section corners.
   - Horizontal and vertical control.
   - Cross sections, profiles, and contours.
   - Land ownership plat maps.

   We propose to subcontract this task to a local registered land surveyor under the control and direction of our Project Geologist. We also propose new aerial topographic mapping in this study to provide better quantity and cost estimates for project features. Field and aerial survey work should be
accomplished in fall 1982 to avoid delays in feasibility studies and cost comparisons.

2. Procedures and Schedule

a. Harza will subcontract all required aerial photo and survey work, and will coordinate its completion.

b. Aerial photography and field work should be obtained in fall 1982 to avoid delays in feasibility work on Iron Creek Diversion Dam.

c. Map compilation, drafting, and ownership studies should be completed as soon as it is clear that the Iron Creek Diversion Dam is the most attractive alternative.

Task H. Geotechnical Investigation. Principal subtasks are as follows for the Iron Creek sites:

1. Geologic Mapping

a. Damsite area.

b. Reservoir.

c. Search for and evaluation of construction materials.

2. Subsurface Exploration

a. Trenching - determine depth to rock, collect samples along the dam axis and in the reservoir area, and explore for construction material.

b. Overburden drilling and testing - perform penetration and percolation tests and obtain undisturbed samples as required; work to be done in conjunction with the core drilling program.

c. Core drilling and pressure testing in rock - obtain ground water data and permeability of the foundation rock. Continuous core will provide data on the stratigraphy and physical properties of the rock and will provide samples for testing.
3. Laboratory Testing
   a. To obtain data on the properties of construction material, overburden, and rock to be used in the design of the project.

4. Reports, Maps, and Other Studies
   a. Report with maps, geologic sections, core logs, and test results.
   b. Seismic risk evaluation, to be part of the report.

5. Evaluate Data and Suitability of site for:
   Zoned Earth Dam.
   Concrete Gravity Dam.
   Roller Compacted Concrete Dam.

6. Develop conceptual, typical cross section designs for dams studied for use by planning engineers.

A drilling program consisting of 6 holes with footage of 100 ft each has been suggested. A review of the logs of 2 core holes drilled at the proposed site early in 1981 indicates that it may not be necessary to drill each hole to a depth of 100 ft. Additional data could be acquired along the dam axis by drilling more holes only to depths sufficient to confirm unweathered bedrock. Deeper holes in the abutment areas and provisions for drilling angle holes have been included in our estimate of drilling costs. For estimating purposes, 600 ft of drilling will be used. Total field time should be about 3-4 weeks.

Results of drilling, testing and mapping will be used to evaluate site suitability for a zoned earth, concrete gravity, or roller compacted concrete dam. Site suitability for any of these three types of dams is a function of foundation strength and construction material availability. The shale formations at the proposed Iron Creek site may make construction of a concrete gravity dam advisable. The relatively low shear strength of shales along bedding planes, especially when wet, may make sliding stability of a gravity dam questionable. A conventional concrete gravity dam also has rather specific construction material requirements. It may be difficult to locate suitable quantities of acceptable aggregate for a conventional concrete dam. This may also be a major factor for earth dam feasibility where
suitable quantities of both pervious and impervious fill and slope protection will be required.

If the economic feasibility of concrete gravity or earth dam construction is marginal, a roller compacted concrete dam will be considered. Aggregate specifications for roller compacted concrete are not as limiting as they are for conventional concrete, and the use of roller compacted concrete would permit construction of a wider, heavier dam to overcome potential sliding problems at minimal cost. Harza has considerable roller compacted concrete experience including designs for a 21 m high section at Guri Dam (Venezuela), tunnel repair and plunge pool restoration at Tarbela Dam (Pakistan), lock walls and stilling basin slab at Corpus Dam (Argentina), and a 60-foot high structure under study for the Twin Falls Project (Idaho). Harza's Senior Concrete and Materials Specialist, Mr. Gary Mass, will be closely involved with all the materials studies for this task, especially for roller compacted concrete. Mr. Mass is chairman of ACI Committee 207-Mass Concrete, the group that produced the report "Roller Compacted Concrete ACI 207.5R-80" (ACI Journ. July-August 1980), which is a comprehensive discussion of roller compacted concrete mixing, placement, properties and design, especially as they relate to dams.

Task I. **Hydrologic Analysis**

1. Two Objectives will be met by this task:

   a. Determine characteristics of floods, for spillway evaluation and layout and for evaluation of diversion requirements during construction.

   b. Determine normal flow characteristics for the river and canals to evaluate diversions and the potential for hydro power production.

2. Flood Studies (Conducted by Simons, Li & Assoc., Inc.)

   a. Assemble and review all existing flood-related studies and records from Wyoming State Engineer, BuRec, U.S.G.S., etc.

   b. Determine the appropriate spillway design flood hydrograph for Iron Creek Diversion Dam, using correlation or flood routing if required. It is
assumed that a completely new design flood study will not be necessary for this project.

c. Determine flood frequencies at the dam site for evaluating diversion works and project layout requirements.

3. Normal daily flow and flow duration studies (conducted by Simons, Li and Associates)

a. Daily flow records at the U.S.G.S. gage Shoshone River Below Buffalo Bill Reservoir (which is also below the Heart Mountain Canal diversion) will be obtained through WATSTORE. Day-to-day variation in flows on the Shoshone River within many months are too large to permit accurate estimates of power and energy outputs with mean monthly data.

b. Major changes in diversion over the period of record (such as beginning of Heart Mountain diversion in the 1940's) will be identified, and records will be adjusted to present-day diversion conditions, or dropped from use in the study if reasonable adjustments cannot be made.

c. The adjusted daily flows will be transposed to the Corbett Dam/Iron Creek Dam area. Correlation with records at the recently installed gage near the Iron Creek site (Shoshone River above Willwood Dam) will be used to account for inflows, etc.

d. The Shoshone River daily flows will be separated into two components: 1) flows diverted to the Garland Canal, and 2) flows passed downriver that are available for hydro generation.

e. The flows will be used to develop daily flow duration curves and as input to Harza's reservoir operation model (for hydro power studies).

f. A second set of flows will be developed, as above, using the assumption that Buffalo Bill Dam will be enlarged as proposed by BuRec. Variation in dam outflow and in diversion of water will be considered.
g. If any water rights applications or proposals for withdrawals that would affect the flows available for project operation are identified by the consultant during the study, they will be brought to the attention of the Commission and the District for possible consideration.

4. Perform Water Rights Evaluation of Iron Creek site (accomplished by Mr. Frank Trelease of Wright Water Engineers in Cheyenne).
   a. Evaluate the requirements for a petition of relocation of the Garland Canal point of diversion.
   b. Evaluate the effects on existing water rights caused by relocating the point of diversion.
   c. Evaluate the water rights implications of operating both Corbett Dam and Iron Creek Projects for hydropower operations.

5. Operation Studies (conducted by Harza)
   a. Harza will set up and run its daily reservoir operation computer program for the two flow conditions described above (with and without enlarged Buffalo Bill Dam) and for a variety of hydro installation sizes and types, to determine project power and energy outputs. The reservoir operation program is written to consider variations in headwater, tailwater, and water conductor head losses; unit efficiencies for various installations; diversions; minimum flow releases; daily peaking; etc.

Task J. Hydroelectric Feasibility

1. Costs for various hydroelectric installations will be estimated as described in Tasks L and M below, on a comparative basis.

2. Power and energy benefits for the hydro installations studied will be developed using operation study results and values for the power and energy determined through discussion with potential purchasers.
3. Hydro costs and benefits will be compared, attractive projects identified, and project feasibility evaluated.

Task K. **Corbett Dam Appraisal**

1. A recommendation on whether Corbett Dam should remain in service with a hydro power plant added, or whether all power generation should be concentrated at Iron Creek Dam, will be presented. The recommendation will be based on studies in Task J above, and on any potential liability, permitting, or operating problems.

Task L. **Preliminary Design Drawings**

1. Preliminary engineering sketches will be initially prepared for various project alternatives. These sketches will be adequate for developing comparative cost estimates needed to select the best from among various alternatives.

   a. An embankment dam (earth and/or rockfill), a concrete gravity dam, and a roller-compacted concrete gravity dam will be compared.

   b. Alternative spillway and outlet works configurations will be considered.

   c. Installed capacity, combination and type of units, and plant location and layout will be considered in evaluating hydro alternatives.

   d. The nature of the Garland Canal intake and a possible flow measurement section will be determined.

2. Drawings

   a. Preliminary design drawings will be prepared for the selected project configuration. The drawing list will include:

      1. Location Map and Reservoir Area
      2. General Plan - (damsite area)
      3. Dam Profile and Sections
      4. Spillway and Outlet Works - Profiles and Sections
      5. Garland Canal Headworks
      6. Hydroelectric Power Installation
b. Drawings will be suitable for inclusion in the final study report (Task P) and in an application for a license to construct the project.

Task M. Cost Estimates

1. Comparative cost estimates will be prepared with the assistance of the cost estimators in Harza's Construction Management Department, to assist in selecting the best development alternative. The estimates will be based on sketches prepared during Task L-1 above.

2. A feasibility-level cost estimate will be prepared for the selected project.
   a. The estimate will be based on drawings in Task L-2, above.
   b. A construction plan and schedule will be prepared as part of the estimating process.
   c. Labor, material, and equipment requirements will be estimated for each major work item.
   d. Associated costs such as land acquisition, engineering design and construction inspection, O&M, and financing costs will be developed in consultation with the Commission and the District.

Task N. Environmental Background Information

The environmental background effort will be necessary to overlay the project engineering concepts developed. The main information collection will be the responsibility of Dr. K. Eggert of Simmons, Li & Assoc. The final work product will be reviewed by Dr. James Thrall of Harza, an environmental scientist with extensive experience in environmental assessment, reports, project mitigation, and public participation programs.

The following major sub-tasks are envisioned:

1. Describe project location and detailed plans for reservoir, diversion dam, and hydropower plant.
2. Address present environment including:
   a. Downstream water use and quality
   b. Social and economic development
   c. Recreation facilities
   d. Geological and mineral resources

3. Coordinate assessment with Wyoming Game and Fish. Conduct concerned agency contact program.

4. Evaluate the impact of Iron Creek Project on the four areas listed in 2.

5. Recommend alternatives and costs of any environmental mitigations measures.

Task O. **Interim Report** (Phase I activity)

1. On or before December 1, 1982, an original and 25 copies of an interim report will be presented to the Commission. It appears that the results of the Phase I work, comparing the upgraded Corbett Dam to a new Iron Creek Diversion Dam, can be presented in this report.

Task P. **Final Report**

1. A comprehensive final report will be prepared to present the results of the studies. An original and 150 copies will be presented to the Commission. The report will include the narrative sections, drawings, maps, charts and graphs, and tables needed to fully describe the project in its final form and the work that led to its selection.

Task Q. **Public Meetings**

1. Harza will assist the Commission in conducting public presentation meetings and workshops during the study period (two such meetings are assumed for this proposal).
a. Graphic material, handouts, slides, transparencies, etc. will be prepared with the assistance of Harza's graphic artists.

b. The project manager, and other technical personnel as necessary, will attend the meetings to assist with technical presentations, answer questions, etc.

c. Meetings might be scheduled when comparisons between Corbett and Iron Creek Dams are underway (Task C, above) and during detailed formulation of the selected alternative (Tasks J, K, L, and M, above).
Part B - SCHEDULE

The attached schedule displays our estimate of the timing and duration of project Tasks A through Q. The schedule assumes a starting date of September 1, 1982 and a completion within eleven calendar months. A final report would be delivered by July 31, 1983, three months prior to the required deadline for the legislative review period. The schedule also provides for delivery of an Interim Report on December 1, 1982. We have proposed initiating Phase II surveying, mapping, and geotechnical activities during Phase I. This is required to accomplish the field work during more favorable weather conditions. These schedule assumptions necessarily involve prompt and timely decisions and approvals. We would enjoy the opportunity of discussing any changes or revisions to the schedule during Task A, Critical Path System analysis.
<table>
<thead>
<tr>
<th>TASK</th>
<th>1982</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OCT</td>
<td>NOV</td>
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<tr>
<td>MONTHS ELAPSED</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**PHASE I – COMPARISON OF ALTERNATIVES**

A. CRITICAL PATH SYSTEM

B. ANALYSIS OF EXISTING FACILITIES
   - RECONNAISSANCE (WHEN TUNNEL IS Dewatered)
   - REVIEW EXISTING RECORDS
   - ANALYSIS

C. COMPARISON OF COSTS
   - RECONNAISSANCE, REVIEW EXISTING INFORMATION
   - EVALUATION

O. INTERIM REPORT

Q. PUBLIC MEETING

**PHASE II – FEASIBILITY STUDY**

F. ALTERNATIVE WORK OUTLINE

G. SURVEYING
   - PHOTOS AND FIELD WORK
   - COMPLETE MAPS, PROPERTY WORK

H. GEOTECHNICAL INVESTIGATION
   - RECONNAISSANCE, FIELD MAPPING
   - DRILLING
   - TESTING AND ANALYSIS

I. HYDROLOGIC ANALYSIS
   - FLOOD STUDIES
   - DEVELOP EXISTING FLOWS
   - DEVELOP RAISED BUFFALO BILL FLOWS
   - OPERATION STUDIES

J. HYDROELECTRIC FEASIBILITY
   - ALTERNATIVES
   - FINAL

K. CORBETT DAM APPRAISAL

L. PRELIMINARY DESIGN DRAWINGS
   - ALTERNATIVE SKETCHES
   - FINAL

M. COST ESTIMATES
   - ALTERNATIVES
   - FINAL

N. ENVIRONMENTAL BACKGROUND

P. FINAL REPORT

Q. PUBLIC MEETING

Harza Engineering Company ● August 1982

IRON CREEK DAM
LEVEL II FEASIBILITY STUDY
SCHEDULE
Part C - COST ESTIMATE

The following table displays the estimated costs for completing Phases I and II. In addition, an estimated cost distribution is itemized by task. The table is arranged to break down costs between Harza and subcontractors, both engineering and vendor services. We have not defined costs estimates for Task D and E which involves a decision by the Shonshone Irrigation District and WWDC whether to rehabilitate the Corbett Dam and Tunnel. We would prefer to discuss the change-of-scope and associated costs at such time as the work is better defined. Our preferred method of payment is salary costs plus overhead and fee as shown on our Schedule-of-Charges from attached to the Draft Agreement - Part E which follows.
<table>
<thead>
<tr>
<th>Tasks</th>
<th>Estimated Costs</th>
<th>Subcontractor Costs</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>A-Critical Path System</td>
<td>$ 2,277</td>
<td>---</td>
<td>$ 2,277</td>
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<tr>
<td>B-Analysis of Existing Facilities</td>
<td>$ 18,200</td>
<td>$ 6,750</td>
<td>$ 24,950</td>
</tr>
<tr>
<td>C-Cost Comparison</td>
<td>$ 13,650</td>
<td>---</td>
<td>$ 13,650</td>
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<tr>
<td>D-Repairs/Existing Facilities</td>
<td>Optional - Costs to be Assigned Pending Outcome of Tasks B, C &amp; F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-Report &amp; Study Termination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Alternative Work Outline</td>
<td>-0-</td>
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<td>-0-</td>
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<tr>
<td>O-Interim Report</td>
<td>$ 6,825</td>
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<td>$ 6,825</td>
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<tr>
<td>Q-Public Meetings</td>
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<tr>
<td>Subtotal-Phase I</td>
<td>$ 45,502</td>
<td>$ 6,750</td>
<td>$ 52,252</td>
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</table>
### IRON CREEK PROJECT
### COST-TASK BREAKDOWN

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Estimated Costs</th>
<th>Subcontractor Costs</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase II</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>G-Surveying</td>
<td>$ 1,100</td>
<td>$ 16,500</td>
<td>$ 17,600</td>
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<tr>
<td>H-Geotechnical</td>
<td>$ 33,000</td>
<td>$ 27,500</td>
<td>$ 60,500</td>
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<td>I-Hydrologic</td>
<td>$ 5,500</td>
<td>$ 16,000</td>
<td>$ 21,500</td>
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<tr>
<td>J-Hydroelectric</td>
<td>$ 16,499</td>
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<td>$ 16,499</td>
</tr>
<tr>
<td>K-Corbett Dam</td>
<td>$ 2,200</td>
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<td>$ 2,200</td>
</tr>
<tr>
<td>L-Preliminary Design Drawings</td>
<td>$ 27,500</td>
<td>---</td>
<td>$ 27,500</td>
</tr>
<tr>
<td>M-Cost Estimates</td>
<td>$ 5,500</td>
<td>---</td>
<td>$ 5,500</td>
</tr>
<tr>
<td>N-Environmental</td>
<td>---</td>
<td>$ 6,750</td>
<td>$ 6,750</td>
</tr>
<tr>
<td>O-Interim Report</td>
<td>(See Phase I)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>P-Final Report</td>
<td>$ 16,499</td>
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<td>$ 16,499</td>
</tr>
<tr>
<td>Q-Public Meetings</td>
<td>$ 2,200</td>
<td>---</td>
<td>$ 2,200</td>
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<tr>
<td><strong>Subtotal-Phase II</strong></td>
<td><strong>$109,998</strong></td>
<td><strong>$66,750</strong></td>
<td><strong>$176,748</strong></td>
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<td><strong>Total-Phases I&amp;II</strong></td>
<td><strong>$155,500</strong></td>
<td><strong>$73,500</strong></td>
<td><strong>$229,000</strong></td>
</tr>
</tbody>
</table>
Part D - TOTAL STUDY COSTS

As shown on the preceding cost breakdown table, we estimate our total cost to complete the work outlined for Phases I and II to amount to $229,000 including $29,500 of engineering subcontracts and $44,000 of field drilling, surveying, and laboratory testing subcontracts.
Part E - SAMPLE CONTRACT

The following document is proposed as an agreement satisfactory to Harza for contractual relations with the Wyoming Water Development Commission. We will openly consider other contract forms, language, or provisions to successfully conclude contract negotiations.
AGREEMENT FOR ENGINEERING
CONSULTING SERVICES

THIS AGREEMENT is made and entered into this __________
day of __________ 19__, by and between HARZA ENGINEERING
COMPANY, a Delaware corporation ("Engineer"), and
("Client").

WYOMING WATER DEVELOPMENT COMMISSION

Client wishes to
1) Determine the feasibility to repair
the Corbett Dam and tunnel.
2) Determine the feasibility of construction
the proposed Iron Creek Project.

located at The Shoshone Irrigation District in Park County, Wyoming;
and to retain the services of an engineering consultant for the
LEVEL II FEASIBILITY STUDY

(the "Project"); and

Engineer is willing to perform services for the compensation and in accordance with the terms and conditions described in this Agreement;

NOW, THEREFORE, in consideration of the mutual benefits which will result to the parties in carrying out the terms of this Agreement, it is agreed as follows:

1. STATEMENT OF SERVICES

Engineer agrees to perform engineering consultant services as defined in the Scope of Work, attached as Appendix I and made a part of this Agreement.
2. **COMPENSATION**

   Engineer shall be paid according to the Compensation Schedule, attached as Appendix II and made a part of this Agreement.

3. **PAYMENT**

   Payment to Engineer shall be made by Client, within thirty (30) days after submittal of the Engineer's monthly invoice. If Client identifies an item in the invoice which appears to be in error, Client may withhold the amount in question, pay the balance of the invoiced amount and provide Engineer with a statement concerning the questioned item. Alternately, Client may pay the full amount of the invoiced amount, provide a statement of the questioned item, and adjustment, if appropriate, will be made in the next subsequent invoice submitted by Engineer.

   If Client fails to make any payment due Engineer for services and expenses within thirty (30) days after submittal of Engineer's billing therefor, the amounts due Engineer shall include a charge at the greater of the applicable maximum legal rate of interest or 2.0% per month from such thirtieth day; and in addition the Engineer may, after giving seven (7) days' written notice to Client, suspend services under this Agreement until it has been paid in full the amounts due it for services
and expenses. During the period of any such suspension, the parties shall have the same rights and obligations as are provided by Subsection 7 (d) of this Agreement.

4. **TIME SCHEDULE**

The services required by this Agreement can be accomplished within approximately ____ calendar months, beginning on the day this Agreement is executed. It is recognized by the parties, that this estimated period of time is contingent upon factors beyond the reasonable control of either party. Both parties will take all reasonable steps to adhere to the time schedule. In no event are either this time estimate or any cost estimates to be considered a guarantee.

5. **TERM OF AGREEMENT**

Unless extended by Amendment, this Agreement shall terminate ____, 1981, which is approximately ____ months after services are expected to be completed.

6. **ADDITIONAL SERVICES**

Engineer shall supply such additional services as requested by client and agreed to by Engineer in connection with the Project. Separate proposals shall be submitted by Engineer for furnishing these additional services. Compensation for such additional services shall be negotiated by the parties and included in this Agreement by a written Amendment.
7. **GENERAL TERMS AND CONDITIONS**

a. **Relationship Between Engineer and Client**

   Engineer shall serve as Client's professional engineering consultant in those phases of the Project to which this Agreement applies. The relationship is that of a buyer and seller of professional services and it is understood that the parties have not entered into any joint venture or partnership with the other. The Engineer shall not be considered to be the agent of the client.

b. **Responsibility of the Engineer**

   Engineer will render engineering services in accordance with generally accepted and currently recognized engineering practices and principles. Engineer makes no warranty, either express or implied, with respect to its services. In no event shall Engineer at any time be liable for special, incidental or consequential damages, including, but not limited to loss of profits, revenue, use or capital, claims of customers, cost of purchased or replacement power, or for any other loss of any nature, whether based on contract, tort, negligence, strict liability or otherwise, by reason of the services rendered under this Agreement.
c. **Changes**

Client reserves the right by written change order or amendment to make changes in requirements, amount of work, or engineering time schedule adjustments, and Engineer and Client shall negotiate appropriate adjustments acceptable to both parties to accommodate any such changes, if commercially possible.

d. **Suspension of Work**

Client may, at any time, by written order to Engineer (Suspension of Work Order) require Engineer to stop all, or any part, of the services required by this Agreement. Upon receipt of such an order Engineer shall immediately comply with its terms and take all reasonable steps to minimize the occurrence of costs allocable to the services covered by the order. Client, however, shall pay all costs associated with suspension including all costs necessary to maintain continuity and the staff required to resume the services upon expiration of the suspension of work order. Engineer will not be obligated to provide the same personnel employed prior to suspension when the services are resumed, in the event the period of any suspension exceeds thirty (30) days. Client will reimburse Engineer for the costs of such suspension and remobilization.
e. **Termination**

This Agreement may be terminated by either party upon thirty (30) days' written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof through no fault of the terminating party. This Agreement may be terminated by Client, under the same terms, whenever Client shall determine that termination is in its best interests. Cost of termination, including salaries, overhead and fee, incurred by Engineer either before or after the termination date shall be reimbursed by Client.

f. **Documents Property of Client**

Drawings, specifications, reports, and any other documents prepared by Engineer in connection with any or all of the services furnished hereunder shall be the property of Client. Engineer shall have the right to retain copies of all documents and drawings for its files.

g. **Reuse of Documents**

All documents including drawings and specifications furnished by Engineer pursuant to this Agreement are intended for use on the Project only. They cannot be used by Client or other on extensions of the
Project or any other project. Any reuse, without specific written verification or adaption by Engineer, shall be at Client's sole risk, and Client shall indemnify and hold harmless Engineer from all claims, damages, losses, and expenses including attorney's fees arising out of or resulting therefrom.

h. **Compliance With Laws**

To the extent they apply to its employees or its services, the Engineer shall comply with all applicable United States, state, territorial and commonwealth laws, including ordinances of any political subdivisions or agencies of the United States, any state, territory, or commonwealth thereof.

i. **Indemnification**

Engineer shall indemnify and hold harmless Client up to the amount of its net fee for the services from loss or expense, including reasonable attorneys' fees, for claims for personal injury (including death) or property damage arising out of the sole negligent act, error or omission of Engineer.

Client shall indemnify and hold harmless Engineer, up to the same amount that Engineer undertakes to indemnify the Client under this Agreement, from loss
or expense, including reasonable attorneys' fees, for claims for personal injuries (including death) on property damage arising out of the sole negligent act, error or omission of Client.

In the event of joint or concurrent negligence of Engineer and Client, each shall bear that portion of the loss or expense that its share of the joint or concurrent negligence bears to the total negligency (including that of third parties) which caused the personal injury or property damage.

j. Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the State of Wyoming.

k. Successors and Assigns

The terms of this Agreement shall be binding upon and inure to the benefit of the parties and their respective successors and assigns; provided, however, that neither party shall assign this Agreement in whole or in part without the prior written approval of the other.

l. Waiver of Contract Breach

The waiver of one party of any breach of this Agreement or the failure of one party to enforce at
any time, or for any period of time, any of the provi-
sions hereof, shall be limited to the particular in-
stance, shall not operate or be deemed to waive any
future breaches of this Agreement and shall not be
construed to be a waiver of any provision, except for
the particular instance.

m. Entire Understanding of Agreement

This Agreement represents and incorporates the
entire understanding of the parties hereto, and each
party acknowledges that there are no warranties, re-
presentations, covenants or understandings of any
kind, matter or description whatsoever, made by either
party to the other except as expressly set forth here-
in. Client and the Engineer hereby agree that any
purchase orders, invoices, confirmations, acknowledg-
ments or other similar documents executed or delivered
with respect to the subject matter hereof, that con-
flict with the terms of this Agreement shall be null,
void, and without effect to the extent they conflict
with the terms of this Agreement.

n. Amendment

This Agreement shall not be subject to amendment
unless another instrument is executed by duly
authorized representatives of each of the parties and
entitled "Amendment to Agreement."
o. **Severability of Invalid Provisions**

If any provisions of the Agreement shall be held to contravene or be invalid under the laws of any particular state, country or jurisdiction where used, such contravention shall not invalidate the entire Agreement, but it shall be construed as if not containing the particular provisions or provisions held to be invalid in the particular state, country or jurisdiction and the rights or obligations of the parties hereto shall be construed and enforced accordingly.

p. **Force Majeure**

Neither Client nor Engineer shall be liable for any fault or delay caused by any contingency beyond their control including but not limited to acts of God, wars, strikes, walkouts, fires, natural calamities, or demands or requirements of governmental agencies.

q. **Subcontracts**

Engineer may subcontract portions of the work, but each subcontractor must be approved by Client in writing.
r. **Access and Permits**

Client shall arrange for Engineer to enter upon public and private property and obtain all necessary approvals and permits required from all governmental authorities having jurisdiction over the Project. Client shall pay costs (including Engineer's employee salaries, overhead, and fee) incident to any effort by Engineer toward assisting Client in such access, permits or approvals, if Engineer performs such services.

s. **Designation of Authorized Representatives**

Each party shall designate one or more persons to act with authority in its behalf in respect to appropriate aspects of the Project. The persons designated shall review and respond promptly to all communications received from the other party.

t. **Notices**

Any notice or designation required to be given by either party hereto shall be in writing, and unless receipt of such notice is expressly required by the terms hereof, shall be deemed to be effectively served when deposited in the mails with sufficient first class postage affixed, and addressed to the party to whom such notice is directed at such party's place of business, which in the case of Engineer shall be:
Harza Engineering Company
150 South Wacker Drive
Chicago, Illinois 60606
(Attention:  )

and in case of the Client shall be:

or such other address either party shall hereafter furnish to the other party by written notice as herein provided.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement on the date indicated above.

HARZA ENGINEERING COMPANY  (CLIENT'S NAME)

By:__________________________  By:__________________________

______________________   ______________________
(Title)  (Title)

Date:__________________________  Date:__________________________
(Use Work Outline from Phase III, Part A of this proposal).
A. Compensation

For the consulting engineering services covered by the accompanying proposal letter, Harza Engineering Company shall be paid monthly the sum of:

1. Salary Costs, plus
2. Overhead Costs and Fee, computed at 85% of Salary Costs, plus
3. Direct Costs

B. Definitions

1. Salary Costs - Actual direct salary payments to all personnel, including officers, engineers, designers, supervisors, draftsmen, other technical personnel, word processors, and other personnel for the time directly engaged on the work; plus payroll charges including vacation, sick leave, and holiday pay, unemployment and payroll taxes, social security contributions, workmen's compensation insurance, retirement benefits, medical insurance and group insurance benefits. Charges for payroll items for 1982 will be computed at 39% of direct salary payments.

2. (a) Overhead Costs - Costs which cannot be allocated to specific projects; examples are general administrative payroll, general stenographic and clerical payroll, rent of office and drafting room space, utilities, depreciation of office equipment, cost of maintaining customary liability and property insurance, etc.

(b) Fee - Payment to the Company for interest on invested capital, readiness to serve and profit.

3. Direct Costs - Costs which are directly applicable to the work such as transportation and subsistence expenses on travel in the interest of the work, long distance telephone, telegraph and telex expenses, reproductions, special insurance, Harza (in-house) and outside electronic computer rental costs, usage of computer programs, model and laboratory testing, aerial and ground surveying and subsurface exploration. When the costs of model and laboratory testing, aerial and ground surveying, subsurface exploration, and outside electronic computer rental costs are not paid directly to the laboratory, contractor, or supplier by the Client, an addition of 10% will be made to cover handling and financing costs.
ATTACHMENT A

COMPLIANCE WITH GENERAL CONDITIONS

Harza Engineering Company and its subcontractors Wright Water Engineers and Simons, Li & Associates, Inc. agree to comply with the General Conditions included as Attachment A in the Request for Proposal. We have complied with General Conditions Nos. 1, 2, 3, and 4 in the submittal of this proposal, and we understand and accept General Conditions Nos. 6, 7, 8, 10, 11, 12, 13, 14, and 15. Brief statements of compliance follow for the remaining General Conditions, Nos. 5, 9, and 16.

A. General Condition No. 5 - Access and Rights of Way

The proposers will be responsible for obtaining all needed access and rights of way and shall be solely responsible for their actions. No special access or rights of way problems are anticipated for this work.

B. General Condition No. 9 - Indemnity for State of Wyoming

Harza Engineering company and its subcontractors are fully insured as described in the draft contract included as Item E in Section III, Work Program, of this proposal.

C. General Condition No. 16 - Non Discrimination

Harza Engineering company and its subcontractors Wright Water Engineers and Simons, Li & Associates, Inc. are equal opportunity employers who have Affirmative Action Programs approved by the Federal government. No person performing work under this contract will be discriminated against because of age, race, religion, color, sex, national origin, or ancestry.
KEY PERSONNEL

Harza Engineering Company

J. C. Jones
W. A. Rettberg
D. R. Baier
D. H. McCandless
L. F. Levy
Dr. W. S. Hamilton
R. A. Paige
G. R. Mass

Simons, Li & Associates, Inc.

Dr. D. B. Simons
Dr. T. Ballestero
Dr. K. Eggert

Wright Water Engineers

F. J. Trelease III
JACK C. JONES
Vice President and Head,
Land Resources Department

Degrees: Master of Science in Civil Engineering
Georga Institute of Technology, 1954
Bachelor of Civil Engineering
Georgia Institute of Technology, 1953

Languages: English and working knowledge of Spanish

Professional Engineer – Florida, Illinois, Kentucky, Michigan,
Montana, New Mexico, North Carolina,
Utah, Wisconsin, and Wyoming

Professional Societies:
American Society of Civil Engineers
Illinois Society of Professional Engineers
National Society of Professional Engineers
United States Committee on Large Dams

Harza Engineering Company since 1956.
Vice President, 1978.
Senior Associate, 1976.
Associate, 1968.
Head, Land Resources Department, 1979 to date; Head, Geotechnical Department including Foundations and Soil Mechanics, Geology, Special Projects, and Mining Sections, 1976-79; Head, Special Projects Section, 1973-76; Head, Foundations and Soil Mechanics Section, 1972-73; Head, Foundations, Soil Mechanics and Geology Section, 1968-72; Engineer, 1956-68.

Experience Highlights:
Project Manager of longwall mining ground control study for the U.S. Bureau of Mines.

Project Engineer on the Northside Project appraisal of nuclear power in conjunction with irrigation, pumped storage, and area development in the State of Washington.

Soil mechanics and embankment design advisor for the 1,000-MW Yacyreta-Apipe hydroelectric project, Argentina and Paraguay, during feasibility studies.

Project Engineer and Lead Geotechnical Engineer for shore protection projects on Lake Michigan.

JACK C. JONES

Project Engineer, Chicago office, and Resident Engineer for the 65-meter high earthfill Ullum Dam, Argentina, during beginning stages of feasibility report. Project Manager through final design and construction.

Project Engineer on a research program for the Mississippi River Commission to investigate new methods of stabilizing the banks of the Mississippi River.

Supervised and participated in preparation of design criteria, layouts, and solving difficult engineering problems on the 100-MW Finchaa Project, Ethiopia; 105-MW Burfell Project, Iceland; Guri Project (fuse plug and rockfill dam), Venezuela; Pearl River; and other smaller projects.

Field Engineer and Company Representative for portion of the exploration program for the 2,067-MW Guri Project, Venezuela, and for preparation of a report for development of the Saramacca and Surinam Rivers, Surinam.

Planning Engineer for Eski Mosul Project, Iraq.

1954 to 1956:
Tennessee Valley Authority, Knoxville, Tennessee.

Civil Engineer, Project Planning Branch, Hydro-Projects Section.

Technical Papers and Articles:


WILLIAM A. RETTBERG
Manager, Denver Office
Harza Engineering Company since 1971.

Manager, Denver Office: 1979 to present.
Foundations and Soil Mechanics Section: Senior Geotechnical Engineer, 1978-79; Project Engineer, 1971-78.
Professional Societies: American Society of Civil Engineers, Society of Mining Engineers, A.I.M.E., American Water Works Association, Consulting Engineers Council of Colorado, A.C.E.C.


As manager of Harza’s branch office in Denver, Mr. Rettberg is responsible for maintaining and expanding the company’s service network in the Rocky Mountain region. He is involved in all types of projects within the region, including hydropower, dams, transmission and distribution, mining and water supply. Mr. Rettberg’s eight years of experience in geotechnical engineering within the Foundations and Soil Mechanics Section involved planning, field exploration, design and construction management of embankment dams, tailings dams, water supply reservoirs, hydro projects, surface mine developments, mine reclamation, chemical waste impoundment, and special studies.

EXPERIENCE HIGHLIGHTS

10 Tailings Dams/Waste Impoundment Projects
• Project geotechnical engineer and coordinator on Copper Mountain (Uranium) Project near Riverton, Wyoming. Studies included design of ore-tailings containment vaults which combined ore processing and reclamation into a single cut-and-cover operation (1979-80).
• Project engineer for foundations and waste impoundment ponds associated with three wastewater treatment plants for an electric utility in Illinois. One impoundment utilizes a fly ash/asphaltic mix to form an impervious liner (1978-79).
• Project engineer on the Tilden Tailings Project near Marquette, Michigan, an iron ore tailings project impounding nearly 100 million tons of waste. Duties spanned planning, field investigations, design, construction documents, and services during construction. Use of innovative cement-bentonite slurry trench cutoff, over two miles in length, up to 80 feet deep, beneath embankment dams to limit seepage (1974-77).
• Project engineer for two major fly ash impoundment projects for electric utilities in Ohio and Kentucky. One project used coarse boiler waste as embankment shell material to construct 5,000 acre-foot impoundment. The other project involved raising an existing embankment by 50 feet to extend the life of the impoundment (1974-77).
• Project engineer for gypsum tailings impoundments in Illinois and Texas for a major chemical corporation. Projects utilized waste gypsum to create additional slurry storage capacity (1972-75).

(continued on back page)

PROPOSED PROJECT MANAGER, IRON CREEK LEVEL II FEASIBILITY STUDY, SHOSHONE IRRIGATION DISTRICT AND WYOMING WATER DEVELOPMENT COMMISSION

Mr. Rettberg’s career includes in-depth experience directly applicable to this assignment. These include the Strontia Springs Diversion Dam Project, the Coal Creek Dam Project, the Carter Mining Studies, the Copper Mountain Project near Shoshone, Wyoming, and numerous other corporate, project manager, and project geotechnical engineering assignments. Mr. Rettberg is a Wyoming Registered Professional Engineer, No. 3009.

As Project Manager, Mr. Rettberg will be responsible for the following activities:

Overall direction and control of the project planning, execution, and outputs.

Establish communication between the District, the Commission, and the engineering team.

Establish and control project budgets and time schedule performance.

Coordinate activities of engineering associate subcontractors and all field subcontractors.

Mr. Rettberg is well prepared for this assignment. Harza’s Denver office location puts him in proximity to the project, the Commission, and our associated engineering firms. The Denver office is well equipped for rapid telecommunications and word processing to expedite the project work. During the project, Mr. Rettberg will devote about 10 percent of his time to the Iron Creek Project and attend contract negotiation, scoping, and public meetings. He will be responsible to the District and Commission to prepare the monthly progress report.

Mr. Rettberg’s ability to handle this assignment is enhanced by his geotechnical engineering experience since 1971. He has personally worked with all the lead engineers, project sponsor, and prime engineering subcontractors over the years. The following reference may be contacted:

Mr. Jack Parsons
Foothills Project Manager
Denver Water Department
303/623-2500 ext. 242
• Project engineer for aqueous chemical holding pond in Illinois that included impervious embankment and reservoir to contain hazardous waste material (1972).

5 Special Projects
• Project manager for a groundwater dewatering and temporary support system study associated with construction of a coal-car dumping and materials handling facility for a Wisconsin electric utility (1978).
• Project engineer for a study to determine stability and safe construction methods associated with a dike on a compressible peat foundation, IL (1978).
• Project engineer for a thermal generating station siting study, including office and field investigations to determine foundation conditions for structures and waste disposal facilities, IL (1978).
• Project engineer for study of seismic response and protective measures to increase stability of a tailings dam adjacent to an open pit iron ore mine subject to frequent blasting, MI (1976).
• Project engineer for a laboratory testing program to determine the physical and permeability characteristics of a self-hardening cement-bentonite slurry used for the first time in a slurry trench cutoff wall in the U.S. (1976).

5 Water Supply Projects
• Project manager for two water supply prefeasibility studies for coal-to-gasoline conversion plants in Wyoming and Montana. Studies determined physical and legal availability of water; geologic conditions for siting diversion dams, storage dams, reservoirs, pipelines and pumping plants; costs associated with water supply; and a permit implementation schedule (1981).
• Project engineer for embankment construction materials exploration for the Coal Creek Project, a municipal and industrial water supply dam, near Boulder, Colorado (1980-81).

• Project engineer for diversion tunnel and abutment keyway excavation for the 292-foot high Strontia Springs arch dam for the Denver Water Board, CO (1979).
• Project manager for a multiple reservoir siting study to augment low flows on a river supplying cooling water to a series of electric generating stations in northwestern Illinois. Studies included reservoir yield analyses to size both on and off stream reservoirs, geologic investigations, and cost estimates (1978-79).

3 Mine Planning Projects
• Project engineer for planning mitigating measures to control acid runoff and leachate migration associated with coal refuse piles at an abandoned mine site in southern Illinois. Study included both short- and long-term control and reclamation measures (1978-79).
• Project engineer for design of surface water diversion, sediment and flood control facilities associated with two major surface coal mines in Wyoming. Work included preparation of state and federal permit applications concerned with water rights and mine safety regulations (1977-78).

2 Hydroelectric Projects
• Project engineer for siting of a dam and upper reservoir for a 2,000 to 3,000 MW pumped-storage generating facility in northern Illinois, including planning and field studies (1978-79).

• Field engineer for embankment materials exploration associated with the upper reservoir and dam for the 2,100 MW Bath County Pumped-Storage Project, VA (1973).

SPECIAL RECOGNITIONS
Co-Inventor of world’s first concrete canoe, University of Illinois, 1970.

TECHNICAL PAPERS AND ARTICLES:
DAVID R. BAIER
Geotechnical Engineer

Degrees: Master of Science in Geology
          University of Wisconsin-Milwaukee, 1976
          Bachelor of Science in Geology
          Dickinson College, 1973

Languages: English and knowledge of German

Professional Engineer – Wisconsin

Professional Geologist – Indiana

Professional Society:
Sigma Xi

Harza Engineering Company since 1975.
Special Projects Section: Geotechnical Engineer, 1975 to date.
Project Engineer for preliminary design of disposal ponds for a lime slurry with a pH of 12.4.
Project Geologist for several studies of abandoned quarries and gravel pits for use as storage reservoirs for power plant cooling water.
Project Engineer for design of riprap erosion repairs and new boatramp and breakwater on Lake Michigan.
Project Engineer for Lake Marian Phase II dam inspection involving preliminary design of new project spillway; subject of discovery depositions; expert witness for State of Illinois.
Field representative for marine geophysical program in a large pumped-storage reservoir.
Assisted in the preparation of 14 FERC Safety Inspection Reports, including Ashton Dam, Montana; Saluda Dam, South Carolina; and Ludington Pumped-Storage, Michigan; involved in inspection and remedial work at over 20 other dams.
Developed dredging plans for intakes of a power station on Lake Michigan; evaluated geotechnical design and construction procedures for new intakes of another Lake Michigan plant.
Assistant Project Engineer, Rehabilitation of Lock and Dam No. 1. Responsibilities included stability analyses, construction scheduling; cost estimating; seepage, piping, and uplift evaluation; installation of structural instrumentation; test grouting; and preparation of project reports. Responsible for preparation of all civil works specifications and review and coordination of all project specifications for this $20 million project.
Conducted preliminary design and planning studies for the expansion of harbor facilities for a major steel corporation on Lake Michigan.
Participated in the design and permitting for construction of a barge dock in Illinois; prepared construction specifications.
Prepared preliminary designs for derrick stone and dolosse armor protection for repair of erosion damage in the tailrace of a large power dam.
DAVID R. BAIER

Performed seepage analyses for a recreational reservoir in Wisconsin subject to large seepage losses.

Performed surface hydrologic analyses for a power plant siting study in the Midwest. Prepared contract documents for subsurface exploration at one site, served as drilling inspector, prepared geologic and hydrologic report for client; participated in oral presentation of results to client and regulatory agencies.

Prepared design and contract documents for installation of a post tensioned anchorage system at a western U.S. power dam.

Project Engineer for design and supervision of repairs to deteriorated spillway bin-type retaining walls at a power plant cooling lake outlet.

Project Geologist for Miraflores Dam (Panama Canal) stability investigations, Lake Vermilion (Illinois) dam inspection and modifications, and the repair and rehabilitation of 14 dams in Westchester County, New York (most recent structure was built in 1917).

Responsible for development of coal unit train rail rates for hypothetical future shipments as part of U.S. D.O.E. study; used ICC Rail Form “A” tariff estimate procedures.

Prepared contract documents for other rehabilitation projects including structural modifications to a pumphouse, repairs to five dams in Michigan, demolition of a powerhouse, construction of a dike toe drain, construction of a conventional and fiber reinforced concrete stilling basin overlay, and construction of a steel-framed building.

1973 to 1975:

University of Wisconsin, Milwaukee, Wisconsin.

Graduate student. Teaching Assistant in Introductory and Glacial-Pleistocene Geology through 1974.

Research Assistant, July 1974 to July 1975, on hydrologic, beach erosion, and Great Lakes ice research projects. Participated in Lake Michigan beach erosion physical modeling project and shoreline inventory program, and prepared an extensive annotated Lake Michigan shore erosion bibliography for publication.

1972 to 1973:


Junior Engineer, Dam Section, Hydraulics Division. Assistant Project Engineer, U.S. Army Corps of Engineers, “Tropical Storm Agnes After-Action Report,” an evaluation of flood damage and the performance of flood control works.

Technical Papers and Articles:

DENNIS H. McCANDLESS
Civil Engineer

Degree: Bachelor of Science in Civil Engineering
Cornell University, 1972

Languages: English and working knowledge of Spanish

Professional Society – Pennsylvania

Professional Societies:
American Society of Civil Engineers
American Water Resources Association
National Society of Professional Engineers
American Society of Photogrammetry

Harza Engineering Company since 1978.
Water and Energy Planning and Design Department: Civil Engineer, Water Resources Planning Section, 1978 to date.

Experience Highlights:
Lead Planning Engineer for the Tembagapura Hydroelectric Project, a 25 MW installation at an existing copper mining project in Irian Jaya, Indonesia. The project will include a run-of-river intake, pressure pipeline and penstock, and powerhouse with impulse turbines. In Indonesia, responsibilities included field reconnaissance, surveys, site access development, installation of hydrometric equipment, and measuring streamflows. In Chicago, responsibilities included developing layouts and cost estimates.

Lead Planning Engineer for a reconnaissance study of a water supply development on St. Lucia, W.I., which includes an embankment dam and a large transmission pipeline. Responsibilities included field reconnaissance, layout and estimate preparation, and report preparation.

Lead Planning Engineer for feasibility studies and a Federal Energy Regulatory Commission (FERC) license application for the Raystown Hydroelectric Project, which involves adding a 20 MW hydroelectric power plant to an existing Corps of Engineers' dam in central Pennsylvania. Responsibilities included tailwater level determinations; evaluation of alternative layouts; reservoir operation and project component optimization studies; assistance with energy and capacity computations, preparation of final layouts and cost estimates, license application exhibit preparation; and presentation of project concepts in meetings with interested agencies.

Responsible for analysis of the effects of the Corps of Engineers’ proposed flood control dam on the Souris River near Burlington, North Dakota, on nine existing water control structures in two national wildlife refuges, and for design of measures to reduce adverse effects; assisted with preparation of the General Design Memorandum for the Burlington Project. Work included hydrograph routing; field evaluation and preliminary design and cost estimating of repairs, improvements, and replacements for structures and embankments; and assembly of all cost estimates for the General Design Memorandum.

In Lahore, Pakistan, assisted in the preparation of a master plan for management of flooding problems throughout Pakistan. Responsibilities included review of existing flood protection plans for specific problem areas; identification of priority projects and studies; preparation of recommendations for increased use of flood simulation modelling; provision of technical assistance to counterpart staff; and preparation of report appendices presenting results of studies.
DENNIS H. McCANDLESS

Responsible for layouts, cost estimates, economic analysis, and report preparation for a study to develop additional reservoir storage on the Zarqa River in Jordan by constructing new rockfill dams or raising an existing dam.

Assisted the Project Manager with coordination of work on Stage II of the Jordan Valley Irrigation Project and the Jordan National Water Carrier study. Completed a reconnaissance study of potential power developments along the Yarmouk River, Jordan, and assisted with a reconnaissance study of power development potential between the Red Sea and the Dead Sea in Jordan. Work included updating layouts and cost estimates from existing studies; preparation of preliminary layouts, preliminary hydraulic and structural designs, and cost estimates for new power schemes; economic analysis of project feasibility; and report preparation.

1972 to 1978:
Michael Baker, Jr., Inc., Beaver and Harrisburg, Pennsylvania.

Civil Engineer, General Civil Engineering Department. Project Manager for water surface profile calculations, and for mapping, for 54 flood insurance studies under subcontract to the Susquehanna River Basin Commission. Responsibilities included project budgeting and scheduling, staff selection and training, cost control, client contact, progress report and invoice preparation, and supervision of engineering, surveying, and drafting work.

Participated as project engineer in all phases of flood insurance studies in Pennsylvania and Mississippi.

Responsible for coordinating data processing for a branch office; start-up, reconnaissance, and hydraulics for a flood insurance study contract in Montana; hydraulic analysis of various flooding problems for flood hazard boundary maps; completion of a number of small water resources, water supply, municipal, and surveying projects; and hydraulic calculations for an urban flood mitigation study.

During a number of short-term assignments, participated in hydrologic and hydraulic studies for river crossing designs for the Trans Alaska Pipeline and a road on Alaska’s North Slope; analyzed the effects of gravel extraction on river hydraulics for several borrow areas along the Trans Alaska Pipeline route; and assisted with hydrologic studies for an acid mine waste abatement project and for evaluation of hazardous coal mine waste embankments.

While assigned to the municipal engineering staff, was responsible for planning, design, and general inspection of construction for a number of sanitary and storm sewers, water lines, and secondary streets and roads.

Served as engineering representative to a number of municipal and private clients, with responsibilities including attendance at council, supervisors’, and planning commission meetings; review of development plans; preparation of contract documents for small municipal construction projects; field analysis of grading, drainage, and other problems; and general inspection of construction.

Involved in feasibility studies, report writing, and preparation of grant and permit applications. Assisted with preparation, adoption, and implementation of flood plain management and grading regulations.

Responsible for or assisted with planning, design, preparation of specifications and bidding documents, and supervision of construction for a variety of site improvement projects including redevelopment projects, residential developments, building projects, and parks.
<table>
<thead>
<tr>
<th>Date of Birth:</th>
<th>December 18, 1927</th>
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</thead>
<tbody>
<tr>
<td>Citizenship:</td>
<td>Bolivia</td>
</tr>
<tr>
<td>Degree:</td>
<td>Bachelor of Science in Civil Engineering, University of Michigan, 1951</td>
</tr>
<tr>
<td>Languages:</td>
<td>English and Spanish</td>
</tr>
</tbody>
</table>

**Professional Experience:**

<table>
<thead>
<tr>
<th>April 1980 to Date:</th>
<th>Harza Engineering Company, Chicago. Head, Estimating and Scheduling Section. Responsible for preparing construction estimates and schedules. Also involved in all aspects of construction planning. Has prepared construction estimates and schedules for the following Harza projects:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yacyreta, Argentina and Paraguay; Mayfield Fourth Unit, City of Tacoma, Washington; Buffalo, New York, Light Rail Rapid Transit, Amherst Station; Hadley Falls Unit 2 Turbines, Holyoke, Massachusetts; Sullivan Lake, Washington; Foothills Project, Denver, Colorado Water Board.</td>
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| September 1968 to September 1971 | Construction Aggregates Corporation, Kingston, Jamaica. Construction Manager Supervised construction management activities for the following Caribbean projects: Rio Cobre Floodway Project, Kingston, Jamaica -- Involved with the construction of earthfill dikes, irrigation bridges and flood control structures. Portmore Development Project, |
September 1968 to September 1971 (Continued)

January 1968 to September 1968:
Macco Corporation, Paramount California
Chief Engineer and Chief Estimator. Supervised construction management activities for all U.S. based subsidiaries of parent firms. Prepared and presented claims involving the Guri hydroelectric project in Venezuela, Dead Sea project in Middle East and the American River Project in the U.S.

September 1964 to January 1968:
Macco Corporation, Kaiser Engineers Joint Venture, Paramount, California
Guri Hydroelectric Project - Venezuela, Chief Engineer.
Involved in all phases of construction engineering management. Prepared schedules construction drawings, designed temporary structures. Supervised subcontractors; participated in labor relations.

March 1964 to September 1964:
Macco Corporation, Kaiser Engineers (Joint Venture), Paramount, California. Assistant Project Manager
Participated in activities leading to the construction of 45 miles of earthfill dikes in the Dead Sea region for water evaporation and potash production.

February 1963 to March 1964:
Macco Corporation, Paramount, California
Project Manager, Middle East Region. Responsible for the construction of canals and auxiliary structures.

September 1961 to February 1963:
Macco Corporation, Paramount, California
Construction Engineer and Senior Estimator
Involved in cost analysis and bid preparation for the following heavy construction projects: Kremasta Dam in Greece; Angat Dam, Philippines; American River, U.S.; McCloud Tunnels, U.S.; Oned Nevanna Dam, Tunisia; Pudahuel Airport, Chile; Canaveral Hydro, Nicaragua; San Luis Dam, California; Rio Lindo Project, Honduras.
Paramount, California
Paloma Dam - Chile
Handled cost estimates for proposal presentations, analyzed construction methods and equipment. Assisted in negotiations for joint venture agreements and government negotiations.

September 1959 to January: Thompson-Cornwall, subsidiary of Macco Pan-Pacific Corporation; New York, N.Y. Guayabo Dam - El Salvador (Units 4 & 5) Responsible for field engineering for tunnels, powerhouse surge chamber, and roads. Designed temporary structures; supervised subcontractors.

May 1951 to April 1957: Thompson-Cornwall, subsidiary of Macco Pan-Pacific Corporation; New York, N.Y. Field Engineer/Construction Supervisor. Held numerous field and supervisory positions early in career.
WALLIS S. HAMILTON
Senior Hydraulic Specialist

Degrees:
Doctor of Philosophy in Fluid Mechanics
University of Iowa, Iowa City, Iowa 1943
Master of Science in Civil Engineering
Carnegie Institute of Technology, 1939
Pittsburgh, Pennsylvania
Bachelor of Science in Civil Engineering
Carnegie Institute of Technology, 1935
Pittsburgh, Pennsylvania

Professional Engineer — Illinois

Professional Societies:
American Geophysical Union
American Society of Civil Engineers

Harza Engineering Company since 1976.
Hydraulic Analysis and Design Division: Senior Hydraulic Specialist, 1976 to date.

Experience Highlights:
Consultation on principles and methods of fluid mechanics. Review and development of analytical techniques and calculation programs. Review of designs and advice on special hydraulic problems.

1943 to 1976:
Northwestern University, Evanston, Illinois.

Professor of Civil Engineering. Responsible for developing hydraulics laboratory and courses in elementary fluid mechanics, open channel flow, hydraulics of civil engineering structures, hydraulic models, viscous and potential flow theory, wave theory and coastal applications, hydraulic transients, hydrology and physical meteorology.

Designed and helped build Reynolds apparatus, small flumes and water tunnel, force- and torque-measuring devices, towing tank carriage and drive mechanism, cavitation test apparatus, wave maker, pipe friction apparatus.

Supervised graduate research on analysis of irregular-wave forces, flow of sludge in pipes, drag forces on submerged bodies when the motion is unsteady (underwater structures), unsteady boundary-layer produced by waves, added mass, water and gas flow in non-linear elastic aquifers, and flood-wave routing. Research involved theory and physical experiments.

Investigated the stability and spray characteristics of flying-boat hulls in waves (towing tank tests) and the break-up of jets and water sheets into spray for the Bureau of Aeronautics, Navy Department.

Analysed the problem of building a physical model of a large portion of the Earth (radial gravity force) to reproduce folding in sedimentary rocks for Carter Oil Company. Measured strains in a preliminary model.
WALLIS S. HAMILTON

Was visiting professor at the University of Khartoum, Sudan, winter 1967 and at Utah State University, Logan, Utah, spring 1962.

1942 to 1943:
University of Iowa, Iowa City, Iowa.
Research Assistant. Measured velocity pattern near a model ship hull fixed in a water channel.

1939 to 1942:
Carnegie Institute of Technology, Pittsburgh, Pennsylvania.
Instructor in Civil Engineering and Mechanics.

1937 to 1939:
Hydraulic Research Laboratory, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.
Assistant Engineer. Helped with design and testing of physical models of flood control structures. These included tunnel outlets, gates, and stilling basins for Tionesta and Crooked Creek Dams, jet deflectors for the sluices at Loyalhanna Dam, cavitation tests at conduit entrances and gate slots, and a highly distorted flood wave model of the Allegheny-Monongahela river system.

1936 to 1937:
Hydrographer (stream gaging).

1935 to 1936:
Tennessee Valley Authority, Knoxville, Tennessee.
Engineering Aide. Made hydraulic computations and preliminary cost estimates.

Technical Papers and Articles:
"Added Mass of a Sphere Starting Upward near Floor" (with G. L. Courtney), submitted to Engineering Mechanics Division, ASCE, January 8, 1976.
"Forces Exerted by Waves on a Sloping Board," Transactions, American Geophysical Union, Vol. 31, No. 6, December 1950.
"Jet Deflectors for the Outlet Conduits of High Dams" (with H. A. Thomas) Civil Engineering, May 1939.
EXPERIENCE HIGHLIGHTS

5 Hydroelectric Projects
Department head and senior geologist on feasibility and design studies for the following projects:

- El Nispero Hydroelectric Project, Honduras. Responsible for feasibility and design studies (1977-78).
- Remolino Hydroelectric Project, Honduras. Responsible for project prefeasibility studies (1977-78).
- San Lorenzo Hydroelectric Project, El Salvador. Responsible for supervision and review of all field geology and design drilling for the project (1977-78).
- Uribante-Caparo Hydroelectric Project, Venezuela. Resident geologist responsible for detailed geologic mapping at dam sites and tunnel alignments, assistance to design, supervision of core drilling, evaluation of construction material, and report preparation. Feasibility studies performed involved four large earthfill and rockfill dams, several tunnels, and power stations (1976).
- Chimbo River Hydroelectric Project, Ecuador. Prefeasibility studies for regional and detailed geologic conditions for multiple sites throughout the Chimbo River Basin. Prefeasibility geologic mapping, detailed geologic studies of numerous developmental schemes, assistance to design, preparation of geologic prefeasibility report, estimating and planning of core drilling and adit exploration for feasibility-stage studies (1975-76).

4 Pumped-Storage Projects

- Powell Mountain Pumped-Storage Project, VA. Preparation of core logging, reconnaissance and detailed geologic mapping, and supervision of core drilling activities (1978-79).
- Stoney Creek Pumped-Storage Project, PA. Resident geologist responsible for core logging, geologic mapping, detailed studies of joint patterns and report preparation (1972-73).
- Bath County Pumped-Storage Project, VA. Involvement with core logging, reconnaissance and detailed geologic mapping, supervision of core drilling, and special subsurface structural studies involving oriented core techniques (1972-73).

PROPOSED PROJECT GEOLOGIST, IRON CREEK PROJECT, SHOSHONE IRRIGATION DISTRICT AND WYOMING WATER DEVELOPMENT COMMISSION

Mr. Paige's long and varied career makes him ideally suited to handle this assignment. This experience includes almost eight years of progressive experience as resident geologist on the Strontia Springs Diversion Dam near Denver, spanning feasibility, design, and construction management phases. During the past three years, Mr. Paige has assumed the role of Rocky Mountain Regional Geologist. In this capacity, he has directed and conducted numerous site investigations in the western U.S., including a recent feasibility and materials exploration program for a 200-foot high fill dam on a complex sedimentary rock foundation in western Colorado.

Mr. Paige's credentials include seismic risk evaluations on two current assignments in Colorado. The following reference may be contacted:

Mr. Quint Hornbach
Chief Geologist
Denver Water Department
303/623-2500.
2 Concrete Arch-Dam Projects

- Resident geologist during construction of the Strontia Springs Dam Project, CO, a 292-foot high thin-arch concrete dam near Denver. As resident geologist, was directly responsible for detailed geologic mapping during construction, rock slope stability, foundation integrity of the dam and all related structures, and preparation of current reports and final project geology report (1979 to present). Earlier experience on the project was as resident geologist (1974-75), involved with planning and estimating core drilling programs, contract administration, assistance to design, preparation of the geologic report, supervision of geologic mapping, core drilling, core logging, and water pressure testing.

- Involved with dam site evaluation, feasibility geologic mapping, core drilling, seismic hazard evaluation, and report preparation for a proposed concrete arch dam in the Tarzwell Mountains for the city of Thornton, Colorado (1979).

Rockfill Dam Project Experience

Resident geologist at Patia 405, Colombia, an 825-foot high rockfill dam. Responsible for geologic mapping, core drilling and logging, for water pressure testing, mapping exploration adits, and for preparation of the feasibility report (1973).

Flood Control Experience

Senior geologist for the evaluation of five dam sites for the Sula Valley Flood Control Project, Honduras (1977-78).

Prior Experience:
1963-72: Engineering geologist specializing in problems of snow, ice, and frozen ground as related to the location of camps, roads, airfields, and other naval facilities in the polar regions. Applied research included studies to determine seasonal changes in strength properties and bearing capacity of sea ice for heavy cargo aircraft, docking areas, floating platforms, and other sea ice structures. Advisor to the U.S. Naval Civil Engineering Corp., Task Force 43, Antarctica.

1962-63: Engineering geologist responsible for geologic mapping of three dam sites, foundation and geologic studies for pipeline, canal and irrigation projects. Work involved shallow-zone seismology, surveying and supervision of core drilling programs.

1959-62: Engineering geologist responsible for classifying material on large excavation projects and helping to determine methods and costs of excavation. Extensive use of shallow-zone seismology. Also responsible for search and evaluation of sand, gravel, jetty stone and riprap.


TECHNICAL PAPERS AND ARTICLES:


GARY R. MASS  
Concrete and Materials Engineer

Degree: Bachelor of Science in Civil Engineering  
South Dakota School of Mines & Technology, 1964

Additional Studies:  
California Department of Water Resources Concrete School,  
Oroville, California, 1964  
California Department of Water Resources Soils School,  
Sacramento, California, 1965  
U.S. Bureau of Reclamation Concrete Control School,  
Denver, Colorado, 1967  
Portland Cement Association Soil-Cement School,  
Skokie, Illinois, 1968  
California Department of Water Resources Radiological Operators School,  
Tracy, California, 1968  
University of Wisconsin Extension Course on Deterioration and Restoration of Concrete,  
Madison, Wisconsin, 1977  
American Concrete Institute Seminar E-701, Aggregates for Concrete,  
Philadelphia, Pennsylvania, 1977  
Portland Cement Association Course on Repair of Concrete Surfaces and Structures,  
Skokie, Illinois, 1977

Professional Engineer — California, Oregon, and Washington

Professional Societies:  
American Concrete Institute (ACI) and Technical Committees  
ACI Committee 207 — Mass Concrete — Chairman  
ACI Committee 210 — Erosion of Concrete in Hydraulic Structures — Corresponding Member  
ACI Committee 211 — Proportioning Concrete Mixes — Member  
ACI Committee 221 — Aggregates — Member  
ACI Committee 309 — Consolidation of Concrete — Member

Foundations and Soil Mechanics Department: Concrete and Materials Specialist, 1973 to date.

Experience Highlights:  
Advises on and participates in exploration and selection of aggregate sources and quarry locations; establishes aggregate and concrete testing programs and evaluates results; prepares concrete specifications for large (mass) concrete jobs and for small (structural) concrete applications; prepares concrete mix designs and supervises concrete quality control testing programs for aggregates, cement, admixtures, and concrete mixtures; reviews contractors’ batching and mixing plants and aggregate plants for job conditions and specification compliance; advises at job sites concerning concrete production, placing procedures or methods, and construction problems; and advises on concrete
coatings, sealants, and other concrete materials. Performs these services for major pumped-storage and hydroelectric projects. Performs safety inspections and investigations of concrete in existing hydraulic structures for serviceability and prepares repair programs as needed.

1969 to 1973:
Kaiser Cement & Gypsum Corporation, Oakland, California.
Division Manager of Technical Services for Oregon, Washington, and Alaska. Responsible for field performance of various types of portland cement produced and marketed by Kaiser and for compliance of these cements with ASTM and various job specifications.
Provided expertise on the chemical and physical properties of portland cement and their relationship to properties of fresh and hardened concrete. Performed concrete testing for small, ready-mix concrete firms including aggregate quality tests, laboratory mix designs, and tests on fresh concrete. Investigated reports of abnormal performance and of defective concrete in which Kaiser cement was used. Provided consulting services on the application, methods, and techniques employed or to be employed in the manufacture or use of portland cement concrete and related materials.

1964 to 1969:
Department of Water Resources, State of California, Sacramento, California.
Assistant Materials Engineer. Responsible for supervising and coordinating the activities of four field laboratories and a staff of 60. Programmed equipment and personnel requirements. Prepared monthly division reports on earthwork and concrete quality control for twelve major contracts including summaries of construction materials used and of testing and test results, and a statistical evaluation of soil compaction data and concrete compressive strengths.
Assigned to the Materials Section of the North San Joaquin Division, State Water Project, on earthwork and concrete quality control for construction of 67 miles of the 10,000-cfs, concrete-lined canal (California Aqueduct); Delta Pumping Plant and Fish Facilities; and Del Valle, Bethany, and Clifton Court Forebay zoned, earthfill dams. These projects involved placement of approximately 1 million cubic yards of portland cement concrete and 16.5 million cubic yards of compacted embankment.
Received on-the-job training at the central water resources laboratory in testing of soil, rock, and concrete materials for the design and construction branches (8 months).
Engineer-in-training (6 months) in the concrete laboratory at the Oroville Dam. Performed field testing for quality control of mass concrete, tunnel lining concrete, and structural concrete at the Oroville Dam, the Thermalito Diversion Dam, and related features.

1963:
Highway Technician. Performed office duties for the Construction Division in Nome, Alaska, including drafting, calculating mass diagrams, and condensing survey notes. Worked as member of survey crew on preliminary design and construction surveys.
Daryl B. Simons  
President and Principal Engineer  
Simons, Li & Associates, Inc.

EDUCATION

Utah State University: B.S. in Civil Engineering, 1947
Utah State University: M.S. in Civil Engineering, 1948
Colorado State University: Ph.D. in Civil Engineering, 1957

REGISTRATION

Registered Professional Engineer in Colorado, Wyoming, and Arizona

TECHNICAL SOCIETIES

American Society of Civil Engineers, Fellow
American Geophysical Union, Member
International Association of Hydraulic Research, Member
International Commission on Irrigation and Drainage, Member

HONORS

J. C. Stevens Award, American Society of Civil Engineers, 1960
Croes Award, American Society of Civil Engineers, 1964
Outstanding Professional Engineer in Colorado, 1973
Karl Emil Hilgard Hydraulic Prize, American Society of Civil Engineers, 1979

SELECTED NATIONAL COMMITTEES

Chairman, ASCE Committee on Regulation and Stabilization of Rivers, 1968-1970

Chairman, UCOWR Committee on Education and Research in Water Resources Engineering, 1970-1971

Chairman, ICID Committee on Collection and Publication of Data Relating to Design of Channels (in regime as well as non-regime), 1969-present

Member, IAHR Committee on Fluvial Hydraulics, 1969-1975

Member, National Subcommittee for the Study of Types of Revetment of the Permanent International Association of Navigation Congresses, 1973

Member, Executive Committee, U.S. Committee on Irrigation, Drainage, and Flood Control, 1976-present
PUBLICATIONS


Over 250 technical papers in the fields of hydraulics, river mechanics, hydrology, and water resources development

EXPERIENCE SUMMARY

Dr. Simons is a world-renowned engineer in the fields of hydraulics, hydrology, river mechanics, hydraulic modeling, and hydraulic structure design. Dr. Simons has supervised over 300 water-related projects, including hydrology, hydraulics, flood control, river geomorphology, sediment transport, water and sediment routing, data storage and retrieval system, navigation, water resources development, data collection, physical modeling, gravel mining permit applications and impact analysis, and hydraulic and erosion analysis of bridges.

Prior to forming Simons, Li & Associates, Inc., Dr. Simons was a professor at the University of Wyoming; Project Chief for the U.S. Geological Survey to conduct research in fluvial hydraulics; and Associate Dean for Engineering Research and Professor of Civil Engineering at Colorado State University. He has served as a hydraulic consultant on numerous engineering projects for the United Nations and federal government agencies dealing with watersheds, river mechanics, flood control, and navigation problems. He has also served on national and international panels delegated to outline research needs in hydraulics, irrigation and drainage, and water resources development.
Thomas P. Ballestero  
Senior Hydrologist  
Simons, Li & Associates, Inc.

EDUCATION  
Pennsylvania State University: B.S. in Civil Engineering, 1975  
Pennsylvania State University: M.S. in Civil Engineering, 1977  
Colorado State University: Ph.D. in Civil Engineering, 1981

REGISTRATION  
Professional Engineering registration in Colorado forthcoming.

TECHNICAL SOCIETIES  
American Geophysical Union, Member  
American Water Resources Association, Member  
National Water Well Association, Member

PUBLICATIONS  
Fourteen publications on the topics of design of nuclear power plant cooling systems, reservoir operating procedures, water resources planning, flood frequency analysis, hydrogeology, hydrology and statistics.

EXPERIENCE SUMMARY  
During the time of his graduate studies at Penn State, Dr. Ballestero was involved with lecturing for continuing education short courses and undergraduate courses dealing with computer simulation of the watershed system, including HEC-1, HEC-2, flood flow frequency analysis, fluid mechanics, and hydrology, and in consulting work dealing with drought flow analysis, sediment and scour studies, and physical modeling of streams. His academic and research interests focused on hydraulics and computer simulation of the watershed environment. After receiving his M.S. degree, Dr. Ballestero taught undergraduate courses in fluid mechanics, hydrology, and river mechanics at Penn State.

At Colorado State University, Dr. Ballestero majored in hydrology and water resources. He performed research on the modeling of underground pollutant transport and the determination of reservoir operating rules.
While at Colorado State University, Dr. Ballestero became Science Editor for Water Resource Publications. His work there included aid in the interpretation of manuscripts, grammatical review and derivation and corroboration of equations.

Dr. Ballestero's work with SLA includes stochastic analysis of daily flows and generation of daily intermittent flows in the Rio Grande watershed, proposals for work and research, a reconnaissance study of low-head hydropower feasibility in the Pacific Northwest, analysis of the hydrology and the scour and deposition periods of the Cowlitz River, lecturing and preparation of notes for short courses and seminars, development of statistical programs to analyze hydrologic data, interpretation of water quality analyses, economic analyses of alternatives, and ground water resources development.
Kenneth G. Eggert
Director of Energy Related Projects
Simons, Li & Associates, Inc.

EDUCATION

Purdue University: B.S. in Aeronautic & Astronautical Engineering, 1969
Colorado University: M.S. in Civil Engineering, 1976
Colorado State University: Ph.D. in Civil Engineering, 1980

REGISTRATION

Registered Professional Engineer in: Colorado, No. 17054
Montana, pending

TECHNICAL SOCIETIES

American Society of Civil Engineers, Member

PUBLICATIONS

30 technical papers and reports in the fields of hydrology, hydraulics, and water resources.

EXPERIENCE SUMMARY

Dr. Eggert's interests have been in the development and application of mathematic simulation techniques to problems in hydrologic and hydraulic engineering. He was instrumental in the development of models used to predict surface water and sediment response from watersheds. Applications of these models include prediction of impacts resulting from land use alternatives, calculation of flows in ungaged watersheds, and migration of wastes and pollutants.

His current responsibilities as Director of Energy Related Projects include oversight of permitting studies. These include environmental baseline studies, permit and licensing applications and environmental studies related to the energy and mining industry. His qualifications for these tasks include a knowledge of the state and federal permit process for surface mining, hydro-power, hazardous wastes, and of the NEPA process in general. He is also supervising preparation of a short course on the design of water diversions and sediment control in minelands.
Projects Dr. Eggert has supervised or in which he has provided a significant input have included development of a flood forecasting and reservoir optimization model for the Pearl River above Jackson, MS, an erosion and sedimentation study for the Chaco National Historical Park, preparation of a hydrology manual for the Office of Surface Mining and miscellaneous hydrology, hydraulics and sedimentation studies. Recent work has also included identification of hazardous wastes disposal methods and sites for the Air National Guard.

Prior to joining Simons, Li & Associates, Inc. in 1980, Dr. Eggert was a Research Associate at Colorado State University, where he was responsible for the development of digital simulations for hydraulic and hydrologic systems, including surface and subsurface flow, alluvial channel hydraulics, sediment detachment transport, and deposition in overland and channel flows. He also supervised and participated in the day-to-day operation of hydraulic model studies in the Colorado State University hydraulics laboratory. His doctoral dissertation provided a comprehensive hydrology simulation for prediction of non-point source pollutant transport. He has lectured on the subject of mechanistic hydrologic calculation of surface water flows for several short courses and has presented papers at numerous national and international technical conferences.
RESUME

FRANK J. TRELEASE III
VICE PRESIDENT
MANAGER, CHEYENNE, WYOMING OFFICE
WRIGHT WATER ENGINEERS, INC.

EDUCATION:
B.S. Civil Engineering - 1959
University of Wyoming

M.S. Civil Engineering - 1961
Colorado State University

REGISTRATION:
Professional Engineer & Land Surveyor - Wyoming
Professional Engineer & Land Surveyor - Colorado
Professional Engineer - Montana

PROFESSIONAL SOCIETIES:

Wyoming Engineering Society
American Society of Civil Engineers
Sigma Xi
U.S. Committee on Irrigation, Drainage, and Flood Control
Wyoming Water Development Association

CURRENT:
WRIGHT WATER ENGINEERS, Vice President and Manager of Cheyenne, Wyoming office

Manager of projects relating to municipal, industrial, and irrigation water supply, urban drainage, dams/reservoirs, water rights, and water conveyance facilities. Consultant and expert witness in water supply studies, water rights analysis, hydrology studies and expert witness for cities, several large farms and ranches, irrigation districts, and industries in Wyoming, Montana and Colorado.

Evaluations/appraisals of water rights, water uses, and delivery systems. Clients include:

City of Casper, Wyoming
Horse Creek Conservation District
Wyoming Hereford Ranch
City of Cheyenne, Wyoming
Warren Livestock Company
Town of Saratoga, Wyoming
Winchester Associates
Western Engineers-Architects, Inc.
Wyoming Water Development Comm.
Gates Rubber Company Ranches

E.E. Sonnenberg & Sons
Utah International
Uranegesellschaft, Ltd.
Arco Coal Co.
Rocky Mountain Energy
Wyoming Highway Dept.
B.B. Brooks Company
BRW/Noblitt, Inc.
Lowham Associates
Mobil

Consulted in an operations analysis of the Alaska water law in 1976.
RESUME
FRANK J. TRELEASE III
(Continued)

EXPERIENCE:  
BRW/NOBLITT, INC.
Vice President, Director of Water Resources

Project management, technical analysis, reports, and expert testimony in the areas of urban drainage and floodwater management, water quality management, ground water resources development and water rights and water supply.

Project manager, Cheyenne Dry Creek Floodwater Management Plan.
Project manager, water quality management study of Cheyenne downtown storm sewer system.
Water rights engineer, Casper, Wyoming.
Analyst and report writer, groundwater and urban drainage studies of land development projects.
Water rights analyst and expert witness for major ranch clients.

WYOMING STATE ENGINEER'S OFFICE
Director of Wyoming Water Planning Program.

Development and administration of the Wyoming State water plan. Management of personnel and funds and Chief Engineer/Hydrologist.

Principal author, State Water Plan, including analyses of the availability of water and related land resources, projections of future water needs, proposals of alternative water resource facilities or programs to meet future water needs.

Administrator, 1975 Wyoming Water Development Act, including supervision of water supply studies of potential dams, irrigation projects. Feasibility study of Gillette municipal and industrial water supply.

Contract negotiator, State purchase and sales of water.

Co-Author, legislation on water development, and river protection systems.

Analyst for several proposed projects including Missouri River to Wyoming aqueduct.

Representative to federal and regional water resources planning programs.

Advisor to the State Engineer on Colorado River and Yellowstone River compacts.

Member, BLM State Advisory Board.

EXPERIENCE:

WYOMING NATURAL RESOURCE BOARD
Water Resource Engineer


COLORADO WATER CONSERVATION BOARD
Senior Water Resource Engineer

Coordination of project planning with local, federal, and state agencies. Legislative consultant. Conduct of water supply studies, engineering cost estimates, and flood control hydrology analyses.

Coordinator, USBR project
Coordinator, SCS PL 566 project
Coordinator, USBR small loans project
Coordinator, Corps of Engineers flood control projects
Coordinator, groundwater studies, water supply

DENVER WATER BOARD
Assistant Hydraulic Engineer

Hydrologist and water rights analyst, Denver Municipal Water Works, specializing in water rights analyses related to short- and long-range planning, operation, and implementation of the water supply system of Denver.

WRIGHT WATER ENGINEERS
Hydraulic Engineer

Studies of water supply, flood control for energy development industries, ski resort developers, municipalities, ditch companies, and other water users. Security water rights for and planning, design, and construction of these projects. Preparation of court testimony involving surface and groundwater rights.

PUBLICATIONS AND REPORTS:

Author and co-author of twenty published and over twenty-five other papers, articles, and reports. Principal author of the Wyoming State Water Plan.
RESUME

PHILLIP S. LEHR

WATER RESOURCE ENGINEER

WRIGHT WATER ENGINEERS, INC.

EDUCATION

B.S. Civil Engineering - 1974
University of Wyoming

Masters of Business Administration - 1975
University of Wyoming

REGISTRATION

Registered Professional Engineer, State of Wyoming

PROFESSIONAL SOCIETIES

Wyoming Engineering Society

CURRENT - WRIGHT WATER ENGINEERS, Cheyenne, Wyoming

Assignments include preliminary pipeline hydraulics and cost estimates; hydrology, hydraulics, and preliminary engineering and cost estimates of potential dams; water supply estimates, consumptive use analysis, and operation studies of water supply projects; water rights evaluations.

Experience in the development and utilization of computerized operation models for the analysis of river basin water supplies. Recent applications include operational studies of Fontenelle Reservoir and resulting sensitivity analysis of streamflows and water quality of the Green River, Wyoming, and systems operational analysis of stream depletions and available water supplies in the Yellowstone River Basin under various scenarios of future development.

EXPERIENCE

STATE OF WYOMING, WATER PLANNING PROGRAM
Water Resource Engineer

Conducted preliminary or reconnaissance level water supply studies for potential water development projects. Developed computer operation studies for single and multipurpose water projects and reservoir operation studies. Prepared spillway and other hydraulic structures hydrology studies for various agricultural, municipal, and industrial water supply projects.

J. T. BANNER AND ASSOCIATES, Laramie, Wyoming
Inspector of construction for downtown Laramie street construction project.

U.S. FOREST SERVICE, Sheridan, Wyoming
Inspector of construction for sewage lagoon system and preconstruction surveying crew chief.
Harza Services Network Expands

Variety in assignments:
Left, inspection of New Croton Dam, New York, built in 1905.
Right, computer-generated structural design of transmission tower.
I am pleased to report that 1981 was a very good year for Harza Engineering Company and its associated companies for overseas work.

Demand for development of natural resources, particularly water resources, continues to be strong both domestically and internationally. Despite economic and political tension in numerous parts of the world during the year, Harza services were called for in increased amounts by many clients. Gross billings were $62 million, up 8% from 1980's $57.5 million.

A new member was elected to the Harza Engineering Company Board of Directors in October, 1981. He is Dwight L. Glasscock, Vice President and head of the Company’s business development and project management operations in the United States and Canada. Mr. Glasscock brings to the Board more than 25 years of experience in management of major water resources projects. We are pleased to welcome him to his new duties.

We were all saddened during the year by the death of one of Harza’s past leaders, Calvin V. Davis. Mr. Davis was President of the firm from 1953 to 1963, and Chairman from 1963 to 1968 when he retired. Mr. Davis’ career accomplishments were many and notable. He was Editor-in-Chief of the widely used “Handbook of Applied Hydraulics” to cite just one example. His life and his dedication to engineering excellence were an inspiration to many of us; he remains vividly in our memories.

Expansion of Harza’s offices in the western U.S.A. continued during 1981, providing an improved basis for delivery of our services to many of our clients. A new office was established in Anchorage, Alaska. The staff of the Denver-area office was expanded, and the office moved to new and larger quarters. Our previously established office in the Phoenix, Arizona, area saw a healthy increase in diversity of assignments during the year. Description of these and other active engagements, more than 130 in total for the year, located in places ranging from the Aleutian Islands to Buenos Aires to Lahore, Pakistan, is presented in the accompanying Annual Review.

A new undertaking at Harza, initiated in 1981, promises to have far-reaching effects on the continued development of the Company. In November, Harza established its Research and Development Central Committee. Members of this Committee are selected on a rotating basis from among the younger engineers and scientists on our staff. The objectives of Committee activity are twofold: development of new techniques and application of new technology in the execution of our project assignments; and identification of new and developing fields to which the considerable range of Harza specialties can be applied.

We believe this program will facilitate involvement of our younger generation of Harza people in important company matters, and it will provide the basis for maintaining in the future the standard of professional excellence to which Harza Engineering Company remains committed.

Richard D. Harza
Chairman and President

Marguerite A. Pugsley, president of the Denver Board of Water Commissioners, congratulates Richard D. Harza at award ceremonies of the Consulting Engineers Council of Colorado. The 300 foot high Strontia Springs arch dam (opposite), designed by Harza for the Denver Water Board, received the Colorado CEC's Engineering Excellence Award (for projects costing $10 million or more) and will now be entering the national competition. The project also received an Outstanding Engineering Achievement award from the American Concrete Institute's Rocky Mountain Chapter.
'81 ANNUAL REVIEW

CONTENTS

Electric Power Systems
  Hydroelectric Generation  2
  Thermal Power Services  8
  Transmission & Distribution  10

Urban Development
  Environmental Protection  12
  Water Supply  14

Mining/Industrial Projects  16

Construction Management  17

Land Resources Projects
  Agricultural Development  18
  Institutional/Management Projects  20

Transportation Projects  22

Computer Control & Communications  22

Dam Inspections & Modifications  23

Officers and Associates  24
Hydroelectric Generation

Development of economical hydroelectric power a key to Harza's growth in 1981

Hydroelectric power continues to be the alternative form of generation favored by nations around the world. For countries with plentiful reserves of oil, the development of hydro potential makes more oil available for export. For nations without fossil fuel reserves, every megawatt of hydroelectric capacity reduces the amount of oil to be imported.

United States

Much of Harza's hydroelectric work in the United States involves adding hydro facilities at existing dams or expanding existing projects. For example, new units are being added at the Mayfield and Boundary projects in Washington. FERC licenses are being sought for power additions at 14 dams in New York state, and in the South Columbia River basin, eight power sites in an existing irrigation canal system are at various stages of development.

Harza's largest U.S. power project, the 2100-MW Bath County Pumped-Storage Project in Virginia, continues under construction at a reduced rate. The present schedule calls for first power by the fall of 1985, a date which meets projected load growth demands and allows a considerable reduction in the rate of construction expenditures in the meantime.

Mr. Paul Ford, a senior geotechnical engineer with extensive experience in the Pacific Northwest and Alaska, has been assigned to head Harza's new office in Anchorage, Alaska. Current hydroelectric work in Alaska includes the Black Bear Lake Project on Prince of Wales Island and the Chester Lake Project on Annette Island. In addition, Harza has recently been selected for a new assignment involving power planning for the Bethel area in western Alaska. The study will determine the most cost-effective and the most environmentally acceptable way of providing energy to Bethel and villages within a 30 mile radius.

An abandoned powerhouse marks the site of the Chester Lake hydro project in Alaska. The new powerhouse will be to the left of the waterfall and will operate under a head of 800 ft. (Photo: R. Leonardson, Harza)

Hydroelectric Generation

<table>
<thead>
<tr>
<th>Sponsor or Client</th>
<th>Project Name</th>
<th>Location</th>
<th>Description</th>
<th>Harza Services*</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Black Bear Lake</td>
<td>Prince of Wales Island, Alaska</td>
<td>Diversion of Black Bear Lake outflow to a 6-MW powerhouse located on a lower lake. Head: 1380 ft.</td>
<td>R G P E L</td>
<td>License applied for</td>
</tr>
<tr>
<td></td>
<td>Chester Lake</td>
<td>Annette Island, Alaska</td>
<td>Diversion of Chester Lake outflow to a 2.5-MW powerhouse discharging to the ocean. Head: 800 ft.</td>
<td>G P</td>
<td>Studies in progress</td>
</tr>
<tr>
<td>Stassen Dale</td>
<td>Hydro additions</td>
<td>New York state</td>
<td>Addition of powerhouses at 14 existing dams. Capacities from 3.5 to 22 MW, heads from 16 to 110 ft.</td>
<td>P L</td>
<td>Studies in progress</td>
</tr>
<tr>
<td>(Long Lake Energy Corp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennsylvania Electric Company</td>
<td>Holwood</td>
<td>Susquehanna River, Pennsylvania</td>
<td>Addition of second powerhouse with four 47-MW bulb units at existing dam. Head: 43 ft.</td>
<td>Update previous planning studies</td>
<td>Assignment complete</td>
</tr>
<tr>
<td>City of Philippi, West Virginia</td>
<td>Tyrget Lake</td>
<td>West Virginia</td>
<td>Addition of 20-MW powerhouse at existing dam. Head: 90 ft.</td>
<td>P L</td>
<td>Permit awarded to others</td>
</tr>
<tr>
<td>Franzo-Carson and Associates (Rancho California Water District)</td>
<td>Rancho California</td>
<td>Temecula Creek, California</td>
<td>Five alternative arrangements, ranging from 1 to 4 MW, using outflow from Vai Lake.</td>
<td>P</td>
<td>Next stage pending</td>
</tr>
<tr>
<td>City of Seattle, Washington</td>
<td>Boundary Project Expansion</td>
<td>Pend Oreille River, Washington</td>
<td>Addition of two 200-MW units at an existing underground powerhouse. Head: 230 ft.</td>
<td>P L D C</td>
<td>License applied for; bids received</td>
</tr>
<tr>
<td>City of Tacoma, Washington</td>
<td>Mayfield 4th Unit</td>
<td>Cowlitz River, Washington</td>
<td>Addition of fourth unit (40.5-MW) at existing powerhouse. Head: 120 ft.</td>
<td>D C S</td>
<td>Under construction</td>
</tr>
</tbody>
</table>

* Services:
- R - Reconnaissance or Prefeasibility
- P - Planning (Feasibility)
- L - License application (FERC)
- G - Geotechnical investigations
- E - Environmental studies
- D - Design
- S - Services during construction
Two major multiple-purpose projects on the Parana River between Argentina and Paraguay are moving closer to realization. The 2700-MW Yacyreta Project with its 72 km of dams and dikes, its two spillways, a navigation lock, irrigation outlets, and 20-unit powerhouse has been advertised for bids. Total project cost is now estimated at about $8 billion. The upstream Corpos Project, which will be similar in size to Yacyreta, is being studied at the feasibility level concurrent with preparation of bidding documents. Engineering for both projects is provided by consortia that include Harza, Lahmeyer International GmbH, and consulting firms from Argentina and Paraguay.

Two projects were nearing completion during 1981. In Iceland, the first two 70-MW units of the Hrauneyjarfoss Project went on line and a third, which was originally planned for installation sometime in the future, is almost complete. In the Dominican Republic, the annual energy generated by the Tavera Hydroelectric Project will be doubled by completion of Bao Dam. The new

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<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Etopia Branch Canal</td>
<td>State of Washington</td>
<td>Capacity: 2.6 MW Head: 122 ft</td>
<td>P, L, O, and S for addition of powerhouses in existing irrigation canal system</td>
<td>In progress</td>
</tr>
<tr>
<td>South Columbia River Basin Irrigation District (Schuchart &amp; Associates, Inc.)</td>
<td>Main Canal Headworks</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Potomac East Canal Headworks</td>
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<td>Potomac East Canal Headworks</td>
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<td>Potomac East Canal Westaway</td>
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<td>Scooteley Irrit</td>
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<td></td>
<td>Summer Falls</td>
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</tr>
<tr>
<td>U.S. Army Corps of Engineers (St. Louis Dist.)</td>
<td>Power/sediment study</td>
<td>France, Switzerland, Austria, Norway, Sweden</td>
<td>Compile case study and operating data</td>
<td>Studies in progress</td>
<td></td>
</tr>
<tr>
<td>Virginia Electric and Power Company</td>
<td>Bath County Pumped Storage</td>
<td>Back Creek, Virginia</td>
<td>A 2103 MW project with a 460-ft high upper reservoir dam, a 136-ft high lower reservoir dam, three 28.5-ft-dia power tunnels, and a pumping-generating station. Head: 1200 ft</td>
<td>G P E L D C S</td>
<td>Under construction</td>
</tr>
<tr>
<td></td>
<td>12th Street Dam</td>
<td>James River, Virginia</td>
<td>Six new tube units (totaling 11.8 MW) to be installed in retired powerhouse</td>
<td>P</td>
<td>Studies in progress</td>
</tr>
<tr>
<td>Argentina</td>
<td>Ullum</td>
<td>San Juan River</td>
<td>Addition of a 40-MW powerhouse at Harza-designed water supply dam. Head: 60 m</td>
<td>D, C</td>
<td>Design in progress</td>
</tr>
<tr>
<td>Argentina/Paraguay</td>
<td>Cordoba</td>
<td>Parana River</td>
<td>Earthfill dam, spillway, navigation lock, and powerhouse of 2300 to 9200-MW capacity</td>
<td>R G P C (With others)</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td>Yacyretas</td>
<td>Parana River</td>
<td>Earthfill dam and dikes totaling 72 km, a 20 unit powerhouse with a capacity of 2700 MW, two spillways, and a navigation lock</td>
<td>R G P E L D C S (With others)</td>
<td>Construction bids received</td>
</tr>
<tr>
<td>Chile</td>
<td>ENDESA</td>
<td>Maule River</td>
<td>A 90-m-high fill dam, spillway, and outlet works for a 470-MW project.</td>
<td>D, C</td>
<td>Design in progress</td>
</tr>
</tbody>
</table>

*Services:
R – Reconversion or Prefeasibility
P – Planning (Feasibility)
L – License application (FERC)
C – Contract documents
G – Geotechnical investigations
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reservoir will soon add its capacity to that of the original through a connecting channel.

For Freeport Indonesia, Inc., work continued on planning for a hydroelectric project that will supply power to the Lembagapura copper mining operations. The project is located in the rugged mountains of Irian Jaya, Indonesia, and will produce 15 to 18 MW.

Design and contract documents are being prepared for the Pehuenche Hydroelectric Project in Chile. An intensive program of foundation exploration, design, and model testing is in progress to facilitate an early construction start.

In Honduras, construction of the 22.5-MW El Nispero Project is nearing completion on the Palaja River. In El Salvador, another step in development of the Lempa River is in progress with construction of the 180-MW San Lorenzo Project with its 46 meter high fill dam.

Detailed design and contract documents are currently being prepared for raising King Talal Dam in Jordan by 16 meters. A 4-MW hydroelectric station will also be added at the dam.

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</tr>
</thead>
<tbody>
<tr>
<td>Dominican Republic</td>
<td>Corporacion Dominicana de Electricidad</td>
<td>Bao Dam</td>
<td>Bao River</td>
<td>R G P D C S</td>
<td>Construction complete</td>
</tr>
<tr>
<td>El Salvador</td>
<td>Comision Ejecutiva Hidroeléctrica del Río Lempa</td>
<td>San Lorenzo</td>
<td>Lempa River</td>
<td>R G P E D C S</td>
<td>Under construction</td>
</tr>
<tr>
<td>Honduras</td>
<td>Empresa Nacional de Energía Eléctrica</td>
<td>El Nispero</td>
<td>Palaja River</td>
<td>R G P D C S</td>
<td>Under construction</td>
</tr>
<tr>
<td>Iceland</td>
<td>Landsvirkjun - The National Power Company</td>
<td>Hrauneyjafoss</td>
<td>Funnsa River</td>
<td>R G P D C S with Thordodson of Iceland</td>
<td>Two of three units installed</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Freeport Indonesia, Incorporated</td>
<td>Tembagapura</td>
<td>Irian Jaya, Indonesia</td>
<td>R G P</td>
<td>Studies in progress</td>
</tr>
<tr>
<td>Jordan</td>
<td>Jordan Valley Authority</td>
<td>King Talal Dam</td>
<td>Zarqa River</td>
<td>P D C</td>
<td>Design in progress</td>
</tr>
<tr>
<td>Venezuela</td>
<td>C.V.G. - Electrificacion del Caroní, C.A.</td>
<td>Guri Expansion</td>
<td>Caroní River</td>
<td>D C (As requested by client)</td>
<td>Under construction</td>
</tr>
<tr>
<td></td>
<td>C.A. Administracion y Fomento Electrico</td>
<td>Urbina-Donadas</td>
<td>AnDES Mountains</td>
<td>R G P D C S (Subcontract to CEH)</td>
<td>Under construction</td>
</tr>
</tbody>
</table>

*Services:
R – Reconnaissance or Preliminary study
P – Planning (Feasibility)
L – License application (FERC)
P – Contract documents
S – Services during construction

The 210-MW Hrauneyjafoss project in Iceland has features designed to divert reservoir ice away from the intake and powerhouse shown here. (Photo: K. Leonardson, Harza)
Thermal Power Services

Harza provides a variety of services to electric utility clients in addition to the planning and design of hydroelectric generation. During 1981, these services were concerned primarily with environmental protection, ash disposal, and the design of diesel-electric facilities.

United States

Process designs for wastewater treatment at the Grand Tower and Meredosia Stations of Central Illinois Public Service Company were among the environmental projects in progress during the year. The studies included the measurement of waste flows, water quality analyses, and treatability studies for all liquid wastes generated at the plant during routine operation, care and maintenance, and from site runoff.

Control of flooding was the primary purpose of a study at Commonwealth Edison Company's Joliet Station. Harza's report recommended site grading and modifications to drainage facilities that would prevent or greatly reduce the magnitude of floods experienced at the station. In another study for Commonwealth Edison, technical, economic, and environmental considerations were evaluated in relation to expansion of the slag field at the Kincaid Station.

Argonne National Laboratory has a study in progress for the Department of Energy that examines, on a national level, the possible effects of future energy development. As part of that project, Harza was retained for a research study that identified and classified potential impacts resulting from the extraction and use of large quantities of coal, oil shale, uranium, and other energy sources on the country's groundwater resources.

Overseas

During 1981, the first 30-MW diesel-generating plant was dedicated at Puerto Cortes, Honduras, and a second 30-MW station to be located at the same site was under design. Bids have now been received and negotiations are in progress for award of contracts.

At the Kincaid Station in Illinois, studies for a slag field with 25 years capacity have been completed. (Photo: B. Knudell, Streeter, IL)

ELECTRIC POWER SYSTEMS

The recently completed 30-MW diesel generating plant at Puerto Cortes, Honduras. A second station of similar size is to be constructed at the same site. (Photo: V. Norkus, Harza)

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<tr>
<td>United States</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Argonne National</td>
<td>Groundwater</td>
<td>National</td>
<td>Groundwater impacts resulting from extraction and use of coal, oil-shale,</td>
<td>Identification and classification of</td>
<td>Study complete</td>
</tr>
<tr>
<td>Laboratory (DOE)</td>
<td>Impact Study</td>
<td></td>
<td>and other energy sources.</td>
<td>potential impacts.</td>
<td></td>
</tr>
<tr>
<td>Central Illinois</td>
<td>Grand Tower</td>
<td>Grand Tower, Illinois</td>
<td>Wastewater treatment at an existing 195-MW coal-fired station</td>
<td>Analysis and flow measurements of</td>
<td>Study complete</td>
</tr>
<tr>
<td>Public Service Company</td>
<td>Station</td>
<td></td>
<td></td>
<td>wastewater, treatability studies,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meredosia</td>
<td>Meredosia, Illinois</td>
<td>Wastewater treatment at an existing 564-MW coal and oil-fired station</td>
<td>process designs.</td>
<td>Study complete</td>
</tr>
<tr>
<td>Commonwealth Edison</td>
<td>Joliet</td>
<td>Joliet, Illinois</td>
<td>Stormwater runoff control at an existing 1475-MW station</td>
<td>Hydrologic studies, runoff estimates,</td>
<td>Study complete</td>
</tr>
<tr>
<td>Company</td>
<td>Station</td>
<td></td>
<td></td>
<td>cost estimates for alternative schemes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kincaid</td>
<td>Kincaid, Illinois</td>
<td>Expansion of slag field at an existing 11.08-MW coal-fired generation</td>
<td>Conceptual designs, cost estimates.</td>
<td>Study complete</td>
</tr>
<tr>
<td></td>
<td>Zion Station</td>
<td>Zion, Illinois</td>
<td>Services at an existing nuclear generating station</td>
<td>Establish performance curves for</td>
<td>Services complete</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>condensor pumps, study pump vibration</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>problems, prepare control panel</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>record drawings.</td>
<td></td>
</tr>
<tr>
<td>Honduras</td>
<td>Puerto Cortes</td>
<td>Puerto Cortes, Honduras</td>
<td>A 30-MW diesel generating plant adjacent to the Harza-designed Puerto</td>
<td>Planning (with and without cogeneration</td>
<td>In progress</td>
</tr>
<tr>
<td>Empresa Nacional de</td>
<td>Diesel Plant No. 2</td>
<td></td>
<td>Cortes plant.</td>
<td>features), preparation of contract</td>
<td></td>
</tr>
<tr>
<td>Energia Electrica</td>
<td></td>
<td></td>
<td></td>
<td>documents, and bid evaluation.</td>
<td></td>
</tr>
</tbody>
</table>
Transmission and Distribution

United States

The largest domestic transmission assignment in progress involves engineering services for the proposed 345-kV Hayden to Blue River line in Colorado. The 95 mile long transmission line will cross Gore Pass at 10,500 feet above sea level, making it one of the highest EHV lines in North America. The line is a project of Tri-State Generation and Transmission Association, Inc., and will connect the Hayden Generating Station with the Blue River substation of Public Service Company of Colorado.

Overseas

Two major distribution projects are in progress in Egypt. In one, distribution systems are being rehabilitated and expanded in four principal urban areas; Cairo, Alexandria, Beni Suef, and Shubin El-Kom. In a related assignment, a new 66/11-kV indoor substation is being designed for Cairo. The second major project involves rural electrification and is nationwide in scope. Subtransmission and distribution systems are being rehabilitated and expanded to 29 towns and 2000 villages.

In Pakistan, a 500-kV upgrading study is in progress by Harza and National Engineering Services (Pakistan) Ltd. (NESPAK). The primary purpose of the study is to identify and plan the modifications to existing facilities that are necessary before the country's new north-south interconnection system can be energized at 500 kV. The new interconnecting lines, 330 miles of which were designed by Harza and NESPAK, were designed to be operated initially at 220-kV, a plan which required little change to the existing system at the time of completion. The Harza section went into service in 1980 and connecting sections are either complete or nearing completion.

In Jordan, a 9-km long, 33 kV transmission line is under design for the power facilities to be added at King Talal Dam.

<table>
<thead>
<tr>
<th>Sponsor or Client</th>
<th>Project Name</th>
<th>Location</th>
<th>Description</th>
<th>Harza Services</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Hayden-Blue River Transmission Line</td>
<td>Colorado</td>
<td>A proposed 95 mile-long, 345 kV transmission line connecting the Hayden generating station and the Blue River substation.</td>
<td>Engineering services during design and construction.</td>
<td>Design in progress</td>
</tr>
<tr>
<td>Egypt</td>
<td>Distribution system expansion</td>
<td>Cairo, Alexandria, Beni Suef, and Shubin El-Kom, Egypt</td>
<td>Rehabilitation and expansion of distribution systems in four major cities.</td>
<td>Preparation of reports, plans, and tender documents; evaluation of bids; test witnessing; surveillance of construction.</td>
<td>Under construction</td>
</tr>
<tr>
<td></td>
<td>Red El-Fang Substation</td>
<td>Cairo, Egypt</td>
<td>66/11-kV indoor substation and associated distribution facilities.</td>
<td>Engineering services for procurement and construction.</td>
<td>Services in progress</td>
</tr>
<tr>
<td></td>
<td>Rural electrification of Egypt</td>
<td>Nationwide</td>
<td>Rehabilitation and expansion of subtransmission and distribution to 29 towns and 2000 villages.</td>
<td>Contract documents and assistance during construction; preparation of standards; construction planning and warehousing.</td>
<td>Under construction</td>
</tr>
<tr>
<td>Pakistan</td>
<td>500-kV upgrading study</td>
<td>Nationwide</td>
<td>Planning study for upgrading 220 kV transmission lines and substations to 500 kV.</td>
<td>Load flow, stability, and TNA analyses: determination of compensation size and type.</td>
<td>Studies in progress</td>
</tr>
</tbody>
</table>

Above: Distribution work in Egypt involves rehabilitation and expansion of systems in four urban areas as well as rural electrification of major areas of the country.

Left: At the Hrauneyjafoss powerhouse, the use of SF6 equipment made it possible to place the 220-kV switchgear indoors, protected from the extreme weather of Iceland. (Photo: J. Sun, Harza)
URBAN DEVELOPMENT

Environmental Protection

Urban development projects play an increasingly important role in Harza’s U.S. business outlook.

Projects for municipalities or related government agencies comprise a significant portion of Harza’s work load. The growth of our urban areas and the need to continue to reduce environmental impacts indicates a growing need for such fundamental services as waste management, water supply, and transportation. It is in these specialized areas that the company provides analytical, planning, and design services.

The Tunnel and Reservoir Plan (TARP) under construction in Chicago is the largest public works project in the United States. The project involves a series of tunnels up to 36 feet in diameter combined with underground pumping facilities and drop shafts to control the present discharges of combined sewage and stormwater into area waterways. When the first stage system goes into operation in the spring of 1984, the combined sewage will overflow into the drop shafts, rather than into the river system, and then into the tunnels. From the tunnels it will be pumped to an existing sewage treatment plant for treatment prior to discharge.

Harza provided design and is presently furnishing resident engineering services for the 31 mile long mainstream tunnel, pumping station, and associated drop shafts. These features have now been excavated and work is in progress on connecting the drop shafts, lining the tunnels, and placing concrete and installing equipment in the twin-chamber underground pumping station. Thus far the project is approximately one year ahead of schedule and $10 million under budget.

A project similar to TARP in concept is under design for the city of Rochester, New York. That project, the Combined Sewer Overflow Abatement Program (CSOAP) will also collect contaminated overflows in tunnels for treatment prior to discharge. Harza’s assignment includes design of the 12 foot diameter Lake Avenue tunnel, the 10 foot diameter Seneca-Norton tunnel, and related drop shafts, overflow and control structures.

Other environmental/sanitary projects are in progress in Glenview, Illinois, and three towns in northern Indiana. The Glenview work is an evaluation of the existing sewer system, and in St. John, Indiana, a new sewer system is under construction. At Dyers, Indiana, the existing sewage treatment plant is being expanded and tertiary treatment facilities are being added.

Environmental Protection

A 35 foot diameter tunnel boring machine as it bored through late in 1983, completing excavation of the 31 mile long mainstream tunnel of the TARP project in Chicago. (Photo: G. Mardyla, Harza)

Harza has construction management responsibility for the five contracts involved in construction of the TARP mainstream tunnel and related structures. The project is currently one year ahead of schedule. (Photo: G. Osborn, Harza)

### Sponsor or Client

**United States**

- Village of Barrington, Illinois
- Metropols Sanitary District of Greater Chicago
- Metropolitan Waste Control Commission
- Rochester sewer overflow abatement
- Town of St. John, Illinois
- Village of Skokie, Illinois

### Project Name

- Telemetering and instrumentation study
- Combined sewer overflow abatement
- Flood control studies

### Location

- Barrington, Illinois
- Chicago, Illinois
- Twin Cities area, Minnesota
- Rochester, New York
- St. John, Illinois
- Skokie, Illinois

### Description

- Staffing/instrumentation requirements for 12 mgd treatment plant
- Expansion of sewage treatment plant, extension of sewer system
- Flood risk reports on Danville, Bloomington, Normal, and McLean County, Illinois
- Evaluation of existing sewer system
- Rehabilitation of pressure filters and other improvements
- System of tunnels up to 35-ft-dia, pumping plants, and future quanlified reservoirs to control combined sewer overflows
- 40,000-sq-ft maintenance/dispatch building with offices, shops, and truck maintenance areas
- 12-ft-dia Lake Ave. tunnel, 10-ft-dia Seneca-Norton tunnel, and related diversion, drop, control, and overflow structures
- Development of sewer system for town with a population of about 4000
- Prevention of basement flooding by controlling inflow to existing combined sewer system

### Harza Services

- Staffing/instrumentation study for design and contract documents, surveillance of construction
- Planning, design, contract documents, surveillance of construction
- Flood hydrology and mapping of flood risk areas for 10-, 50-, 100-, and 500-year floods
- Identification of excessive infiltration/inflow using smoke tests, dye tracer. and video examination
- Planning, contract documents, surveillance of construction
- Planning studies for entire system, followed by design, contract documents, and resident engineering services for the Mainstream tunnel and pumping plant
- Planning, detailed design, cost estimates
- Design report, geotechnical program, hydraulic model studies, detailed design and contract documents
- Consulting services to Board of Trustees (rate studies, subdivision review, etc.), services during design & construction

### Status

- Study complete
- Under construction
- In progress
- Construction complete
- Design complete
- In progress
- Under construction
- Study complete

Left: Sewer system construction at St. John, Indiana. (Photo: J. O'Day, Harza)

Below: Drop shaft model tests for the combined sewer overflow abatement program, Rochester, New York, were carried out at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota. Piaern Dahlin, scientist at St. Anthony Falls, is shown with the final design model.
added. Work at Lowell, Indiana, involves the rehabilitation of pressure filters and other improvements to the treatment plant.

A timely study for the village of Barrington, Illinois, involved the feasibility of adding instrumentation and telemetry equipment at their sewage treatment plant. This would allow a reduction of staffing from the present 24-hour schedule to one or two shifts. The system is expected to be implemented in the near future.

In Colorado, two major water supply projects are in progress. The Foothills Project of the Denver Water Department will soon add a much-needed 125 mgd to that city’s water supply. Harza’s participation in the project has involved planning, design, and resident engineering for the Strontia Springs diversion dam and intakes on the South Platte River. The dam is a 300 foot high concrete arch with an overflow spillway, eight outlet valves, and an auxiliary spillway.

For the city of Thornton, Colorado, a feasibility study is in progress for a dam and water supply reservoir on Tarryall Creek, involving site selection and selection of type of dam, foundation exploration, environmental studies, and hydrology.

Existing water supply facilities projects took Harza specialists to Denver and New York. The work in Denver involved: 1) investigation of 200 miles of transmission mains which supply a peak demand of 2200 mgd from five treatment plants, 2) identification of problems and preparation of a 40 year plan of improvement, and 3) inspection and plans for rehabilitation of tunnel and substructure systems at an aging 350-mgd treatment plant. In New York, Harza was retained to inspect 14 water supply dams and the Catskill Aqueduct which supply water to New York City.

### Water Supply

Harza’s water supply work takes two essential forms: 1) where water is scarce, Harza performs hydrologic studies and the design of reservoir storage or groundwater development to provide dependable raw water supply; and 2) the company designs treatment and distribution facilities to deliver potable water to the consumer.

In Colorado, existing combined sewers was under study. In Danville, Bloomington, Normal, and McLean County, Illinois, flood insurance studies continued for the Federal Emergency Management Agency. These studies involve delineation of flood risk areas for floods of 10, 50, 100, and 500 year frequencies.

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**Upstream view of Strontia Springs dam in Colorado which will soon begin diverting water to Denver’s new Foothills water treatment plant. (Photo: Paul Fletcher, Denver)**

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**Water Supply**

<table>
<thead>
<tr>
<th>Sponsor or Client</th>
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<th>Location</th>
<th>Description</th>
<th>Harza Services</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver Board of Water Commissioners</td>
<td>Foothills Project</td>
<td>South Platte River, Colorado</td>
<td>300-ft high Strontia Springs arch dam and intakes to divert water to 125-mgd water treatment plant</td>
<td>Predesign report, detailed design, contract documents, resident engineering services.</td>
<td>Under construction</td>
</tr>
<tr>
<td></td>
<td>(Strontia Springs Dam)</td>
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<tr>
<td></td>
<td>South Platte River basin study</td>
<td>Colorado</td>
<td>Determination of probable maximum flood and stability analyses of two dams upstream of Foothills Project</td>
<td>Detailed hydrometeorologic and flood studies; structural inspections and analyses.</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td>Clifton Dam outlet works</td>
<td>Blue River, Colorado</td>
<td>Two new sluice gates and a 24-inch jet-flow gate in existing outlet works.</td>
<td>Design studies and cost estimates for outlet works improvements.</td>
<td>In progress</td>
</tr>
<tr>
<td>Detroit Water Department</td>
<td>Water system evaluation</td>
<td>Detroit, Michigan</td>
<td>Improvement of water system, including 5 treatment plants, serving a population of 0.4 million.</td>
<td>Inspection, development of alternatives; cost estimates; recommendations for improving system.</td>
<td>Study complete</td>
</tr>
<tr>
<td></td>
<td>Computer services</td>
<td></td>
<td>Provide software and computer time for continuing engineering analysis.</td>
<td></td>
<td>Assignment continuing</td>
</tr>
<tr>
<td>Inter-State Water Company</td>
<td>Raising Lake Vermilion Dam</td>
<td>Danville, Illinois</td>
<td>Raising the level of Lake Vermilion by 5 feet and increasing spillway capacity.</td>
<td>Preliminary design of alternatives; assistance with securing permit to raise pool level.</td>
<td>Study complete</td>
</tr>
<tr>
<td>City of New York,</td>
<td>Inspection of water supply facilities</td>
<td>New York State</td>
<td>Inspection of 14 water supply dams and portions of cut-and-cover conduit in Catskill Aqueduct.</td>
<td>Review of records &amp; field inspections: underwater, drilling &amp; testing programs.</td>
<td>In progress</td>
</tr>
<tr>
<td>Department of Environmental Protection</td>
<td></td>
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<tr>
<td>Pearl River Valley</td>
<td>Ross Barnett Reservoir study</td>
<td>Mississippi</td>
<td>Updating reservoir operation criteria.</td>
<td>Derivation of rule curves for flood operation and for non-flood water supply and recreation operation.</td>
<td>Assignment complete</td>
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<tr>
<td>Water Supply District</td>
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<tr>
<td>City of Thornton,</td>
<td>South Park Reservoir</td>
<td>Tarryall Creek, Colorado</td>
<td>Dam and water supply reservoir.</td>
<td>Review earlier studies; preparation of feasibility study and permit application.</td>
<td>In progress</td>
</tr>
<tr>
<td>Colorado</td>
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MINING/INDUSTRIAL PROJECTS

Application of water planning, geotechnical, and environmental techniques to mining and industrial projects

The ways in which energy is recovered from fossil fuels will undergo a marked transformation during the 1980's if the momentum gained during the last decade is not lost to current fiscal constraints. Among the conversion techniques currently under large-scale development are coal gasification (and processes that use the gas created as a feedstock for producing liquid fuels) and the recovery of oil from tar sands and oil shale deposits. More direct methods of distributing the energy from western coal, including the increased use of unit trains, coal-slurry pipelines, and by transmission lines from generating stations located at mine sites, will also play a part in utilizing this important resource.

Water Resources Development

The technical feasibility of these new conversion and distribution methods is no longer in doubt; they are all being used commercially or experimentally somewhere in the world. Aside from economics, the principal constraint in many cases is the impact of commercial-sized developments on area water resources and the environment. Harza hydrologists, engineers, and environmental scientists have been solving these problems for energy and mineral projects throughout the United States and several foreign countries.

A brief summary of representative water supply assignments in progress during 1981 is presented below. (Because many of the projects are in sensitive stages of planning or development, the name of the owner and the exact location is not indicated.)

• Development of a plan that would supply 15,000 acre-feet of water per year to a proposed coal-based synfuels project in Montana.

Waste Management and Environmental Protection

A variety of environmental and waste-handling considerations must be resolved before mining and industrial projects receive permits to operate. During 1981, Harza was involved in environmental work for facilities in various stages of planning, operation, or reclamation. Services provided included:

- Baseline environmental surveys
- Groundwater and surface-water protection
- Wastewater treatment
- Solid waste and tailings management
- Hazardous waste management
- Planning and permitting assistance

Among the project types and the problems studied were:

• A continuing assignment to monitor water and sediment quality, fish and macroinvertebrate populations in a river receiving runoff from an industrial site to determine long-term effects.

Above: Robin Glaspey, Harza hydrologist, installing crest stage gage as part of hydrologic studies for the Small Operators Assistance Program related to surface mining in Indiana. (Photo: R. Drews, Harza)

Below: Kenneth Faught, geologist, and Larry Emerson, engineer in the Soil Mechanics and Foundation Section, were part of a Harza crew in Irian Jaya to study hydro power potential near copper mining operations of Freeport Indonesia, Inc. (Photo: H. Chen, Harza)

• Preliminary design of a water supply dam for an oil shale project to be located in Colorado.
• Water supply for an oil refinery in the Caribbean area.
• A study to identify potential water sources and estimate conveyance costs for a tar sands recovery project in Utah.
• Pilot-plant studies to develop an efficient and dependable method of removing oil from oily wastewater.
• Water supply planning for a coal-based energy development in Wyoming.
• Study of the impacts of proposed surface mining on water resources in Davies County, Indiana, as part of the Small Operators Assistance Program.
• Control of acid runoff from slag piles at an abandoned coal mine in Illinois and monitoring of the effectiveness of the measures adopted.
• Review of a wastewater treatment plan based on rapid infiltration for a major food processing firm.
• Study of possible PCB (polychlorinated biphenyl) contamination in river silts near a manufacturing plant.
• Study of lime kiln waste disposal for a plant in Michigan.

Geotechnical Design
Harza's geotechnical staff totals more than 50 people and includes geologists, geohydrologists, soil mechanics engineers, and soil scientists. The experience of this staff is applied to mining/industrial work through the design of foundations, embankment dams, slurry ponds, tailings piles, excavation slopes, and tunnels, shafts, and underground chambers. In addition, they participate in groundwater investigation and protection studies, drainage and erosion control work, and site reclamation planning. Some current projects in which geotechnical services are the principal activity include:

• Subsurface exploration program for a previously designed tailings impoundment (ultimate height, 100 feet) at a phosphate mine and concentrator in Idaho.
• Design of slurry pond and coarse tailings disposal at a new underground coal mine in Illinois.
• Foundation exploration for a water supply dam in Colorado.

Mining/Industrial Clients — 1981
Amerada Hess Corporation
Beker Industries Corporation
Dow Chemical Company
Exxon Minerals Company
General Electric Company
General Mills, Inc.
Hydra-Matic Division, General Motors
Idaho Frozen Foods Corp., sub. Consolidated Foods Corporation
Mobil Corporation, Mining and Coal Division
Olin Corporation
Standard Oil Company (Indiana)
Turris Coal Company (Shell Oil Company)
Weyerhaeuser Company

Harza's Construction Management Department is one of the fastest growing in the company. The current staff of 153 performs a broad range of office and field services:

• review of designs for optimization of construction process
• construction and equipment supply contracts planning, scheduling, cost estimating and coordination
• detailed construction task planning, scheduling, cost estimating and coordination
• equipment and materials purchasing and shipping
• field quality control and assurance
• progress and record reporting, data processing and data storage
• shop inspections and expediting for major electrical and mechanical equipment
• contract and project cost control
• project technical record preparation and retention

Approximately 20% of Harza's construction management specialists are based in the Chicago office; 30% are at seven overseas field offices, and 50% are at eight U.S. site offices. The 15 current projects involve dams and hydroelectric projects, power transmission lines, power distribution and substation facilities, tunnels and underground structures, irrigation projects, sewers and sewage treatment plants, and energy minerals projects.

Four current construction management projects include: Chicago Tunnel and Reservoir Plan (TARP, $2.5 billion construction cost); Guri Hydroelectric Project, Venezuela ($3 billion approximate construction cost); the Bath County Pumped-Storage Project, Virginia ($1.75 billion construction cost); and the Strontia Springs concrete arch dam of the Denver, Colorado Foot hills Project. For CVG-EDELCA's Guri Dam, a key staff of 16 handles the construction quality control organization for one of the world's largest hydroelectric projects.

Municipalities and agencies have utilized Harza's construction management services for smaller scale projects, such as Dyer, Indiana's sewer system expansion; treatment plant improvements in Lowell, Indiana; and the rehabilitation of Piney Dam, Clarion, Pennsylvania.

DCPS Comes on Line
During 1981, Harza's computer scientists began implementation of their Data Correspondence Processing System (DCPS). It has a nearly limitless capacity to handle all items relating to physical data, correspondence, reports, cost and budgets, and schedules.

DCPS indexes all data from conventional forms such as payroll records, inspector's reports, and concrete temperature records, and applies the information to production payments, scheduling, technical evaluation, cash flow projections, and adjustment of claims. The system provides a fast, reliable management tool based on the many types of data generated on a construction project.
**LAND RESOURCES PROJECTS**

**Agricultural Development**

Agricultural projects provide economic and technology-transfer benefits in addition to increased food production.

In recent years, Harza's land resources work has been directed as much at developing self-sufficiency at the farm and institutional levels as at the design of structural solutions to problems. Construction of new water supply, drainage, and irrigation facilities continues to be important, however, and in some countries is the only way to significantly increase food production.

A project in which all of these considerations were examined is the Small-Scale Irrigation Sector Project in Bangladesh. Harza assisted in the development of the planning capability for the Water Development Board, and the identification and ranking of 59 potential small irrigation projects. The result is six initial projects, examined at the feasibility level, and subsequently scheduled for early implementation. All of the projects studied are small enough to be constructed quickly, and inexpensive enough so that limited development funds can be used to benefit the maximum number of people.

**United States**

In the arid areas of the southwestern United States, a dependable water supply is the difference between flourishing crops and desert conditions. In a project sponsored by the Bureau of Indian Affairs, Franzoy-Corey and Associates of Tempe, Arizona, and Harza are developing a project that will supply 30,000 acre-feet of water per year to the Ak-Chin Indian Community. The project includes a new well field in the Vekol Valley, a 30 mile long conveyance system, and on-reservation link facilities. Additional water will be supplied from the Central Arizona Project to accommodate annual needs of 85,000 acre feet.

An interesting study recently completed in Minnesota for John M. Klooster, examined the feasibility of using peat as a fuel and feedstock in such applications as the processing of soybeans and the pelleting of grains and legumes. While the study found the uses uneconomical under today's market conditions, the work is sure to find future application.

**Overseas**

In other parts of the world, work continued on a 12,000 acre drainage and irrigation project in Jamaica and on the 30,000 hectare Jordan Valley irrigation system in Jordan. In Pakistan, the 55,000 hectare Mardan irrigation system is being rehabilitated and expanded in one of several Salinity Control and Reclamation Projects (SCARPs) in progress or planned by the Water and Power Development Authority.

(continued next page)
In Senegambia’s Lower Casamance region, an area of about one million hectares, work began last year on preparation of a master plan, planning of projects identified in the master plan, and design of an early implementation project covering 2500 hectares. Realization of the area’s total potential will require consideration of the cultural preferences of the people living in the region, as well as solutions to such technical problems as the supply of additional water for irrigation and the control of tidal intrusions.

Other projects completed or in progress during the year included the design of water supply dams for irrigation in Tanzania, and an environmental profile of Zaire.

In the Lower Casamance region of Senegambia, planning is in progress to provide dry-season water supply and control tidal flows in agricultural areas. (Photo: P. Ames, Harza)

**Institutional/Management Projects**

Institutional-management services are broadly related to almost any of the governmental, social, financial, or infrastructure considerations required to implement and operate development projects. Much of Harza’s agricultural work is concerned with some aspects of institutional and management development. The work in Bangladesh, for example, includes three objectives: the selection and planning of specific projects, the preparation of planning guidelines to be used by client planners in the future, and recommendation of organizational changes that will accelerate project implementation.

In Bolivia, the Ministry of Planning and Coordination retained Harza for an institutional analysis of the Chaco region. The study will result in an organizational plan for the various public and private agencies involved in development work in the 160,000 square kilometer region.

Harza specialists assisted two of the major international lending institutions during the year. Technical advisory services were provided to the World Bank on water resources master planning in Egypt, and assistance was provided to the Inter-American Development Bank on a feeder-road loan application in El Salvador.

The training of client personnel takes a variety of forms, ranging from the guidance of counterpart personnel during the development of a project to establishment of training schools. Another form involves the development of training programs in which trainees are instructed in various working situations in the United States. A program of this kind is in progress for 23 operation and maintenance engineers from the Tarbela Hydroelectric Project in Pakistan.

**Computer-generated visual aid used to illustrate the minimum movement of soil needed to level a field for irrigation.**

**Institutional/Management Projects**

<table>
<thead>
<tr>
<th>Sponsor or Client</th>
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<th>Location</th>
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</tr>
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<tbody>
<tr>
<td>Senegambia</td>
<td>Societe pour la Mise en Valeur Agricole de la Casamance (SOMIVAC)</td>
<td>Lower Casamance Master Plan</td>
<td>Senegambia Planning for 1-million hectare area, design of initial 2500 hectare project.</td>
<td>Agricultural master plan followed by project feasibility and design.</td>
<td>In progress</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Rufiji Basin Development Authority</td>
<td>Stegljer Gorge reservoir clearing</td>
<td>Tanzania Optimum plan for treatment of vegetation in 1000-sq-km reservoir area.</td>
<td>Survey of types and value of vegetation, water quality and aquatic plant growth projections.</td>
<td>Assignment complete</td>
</tr>
<tr>
<td>Thailand</td>
<td>Royal Irrigation Department</td>
<td>Nam Mun and Lam Sao Dams</td>
<td>Thailand Two 26-m-high earthen dams to supply water for the 2,000-ha Nam Mun irrigation project.</td>
<td>Foundation exploration, design, and contract documents, resettlement plans.</td>
<td>In progress</td>
</tr>
<tr>
<td>Zaire</td>
<td>U.S. Agency for International Development</td>
<td>Environmental profile</td>
<td>Zaire Environmental characteristics and their effects on economic and social development.</td>
<td>Assessment of major environmental problems.</td>
<td>In progress</td>
</tr>
</tbody>
</table>

**Irrigation/Agriculture**

<table>
<thead>
<tr>
<th>Sponsor or Client</th>
<th>Project Name</th>
<th>Location</th>
<th>Description</th>
<th>Harza Services</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Bangladesh Water Development Board/World Bank</td>
<td>Water resources planning</td>
<td>Bangladesh Strengthening of water-sector planning capability within client organization.</td>
<td>Preparation of planning guidelines and assistance with master planning.</td>
<td>In progress</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Ministry of Planning and Coordination</td>
<td>Chaco Boliviano institutional study</td>
<td>Bolivia Institutional analysis of public and private agencies involved in Chaco region.</td>
<td>Formulate and recommend institutional planning.</td>
<td>In progress</td>
</tr>
<tr>
<td>Egypt</td>
<td>World Bank</td>
<td>Water resources master plan</td>
<td>Egypt National water resources planning.</td>
<td>Advisory services.</td>
<td>Assignment complete</td>
</tr>
<tr>
<td>El Salvador</td>
<td>Inter-American Development Bank</td>
<td>Feeder road appraisal</td>
<td>El Salvador Feeder road development in rural areas of El Salvador.</td>
<td>Feasibility analyses for rural road loan application appraisal.</td>
<td>In progress</td>
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<tr>
<td>Pakistan</td>
<td>Water and Power Development Authority</td>
<td>Phase I training program, Tarbela</td>
<td>Pakistan Training program for operation and maintenance engineers.</td>
<td>Devise and arrange training program in the U.S. for 25 engineers.</td>
<td>In progress</td>
</tr>
</tbody>
</table>
TRANSPORTATION PROJECTS

Harza's transportation and shipping projects range from highways and rapid transit systems to navigation locks and dock facilities. During the past year, construction of one rapid transit project was completed and another was under design. The completed project was the Harza-designed section of the Washington, D.C. METRO system. The new section, which was opened to the public December 5, 1981, adds two miles and three stations to the Rockville Route. The station vaults are excavated from solid rock and each is approximately 800 feet long and up to 160 feet below ground. The 204 foot long escalators at the Woodley Park-Zoo Station are the second longest in the world.

Harza, in association with others, is currently designing the Amherst Station of the Buffalo Light Rail Rapid Transit System for the Niagara Frontier Transportation Authority. The station will be 300 feet long with adjacent surface facilities. Construction will be by cut-and-cover methods.

Highway work during 1981 included designs and specifications for the rehabilitation and modification of five bridges in the Northwest Tollway near Chicago, and other assignments under subcontract to Vollmer Associates, Inc. The latter involve work on the Interstate highway system for the Illinois Department of Transportation and include soils and drainage designs for a 6-lane by-pass around East St. Louis.

Harza's long-time association with the U.S. Army Corps of Engineers continued with a series of assignments concerned with Mississippi River navigation and other projects of the St. Louis District.

COMPUTER CONTROL AND COMMUNICATIONS

The computer revolution has had profound effects on the collection, analysis, and storage of data. These capabilities have, in turn, had a marked influence on the operation, monitoring, and control of projects. The following list illustrates the variety of projects on which Harza's Computer Control and Communications Section is providing services.

- Power system operations center, combining control and resource optimization in generation and transmission systems in El Salvador.
- Computer control and monitoring of six pumping-generating units totaling 2100 MW for the Bath County Project in Virginia.
- Control of irrigation flows, including monitoring of crop conditions and optimization of water use in the Jordan Valley.
- Computer directed control of tunnel systems and pumping stations for the Tunnel and Reservoir Plan, Chicago.
- Remote control of outlet valves at Strontia Springs Dam in Colorado.
- Consulting services for communications systems for the Illinois Toll Highway Commission.
- Computer directed demand metering system for 150 substations in the Soyland Power Cooperative, Illinois.
- Monitoring and telemetering of operating conditions at the Barrington, Illinois wastewater treatment plant.
- Data collection and communications systems, including microwave, VHF radio, and satellite ground stations, for a hydrometeorologic network in the Caroni River basin in Venezuela.
- Control of hydroelectric generation at Guri, Yacyreta, Uribante-Caparo, Hrauneyjafoss, and other stations.
**DAM INSPECTIONS AND MODIFICATIONS**

Inspections were performed on 19 dams during the year. Some were in response to FERC 5-year inspection regulations and others were part of regular inspection and maintenance programs. Rehabilitation of three dams was in progress. At the 60 year old Piney Dam in Pennsylvania, rehabilitation work typically includes removal and replacement of concrete, modifications to the spillway gates (including the addition of side seal heaters), and installation of post-tensioned anchors in portions of the dam.

Miraflores Dam is at the Pacific end of the Panama Canal. Work there involves construction of a new stilling basin downstream of the existing spillway.

![James Passage, head of the Special Projects Section, taking soundings during inspection of Dixon Dam in Illinois. (Photo: J. McDonnell, Harza)](image)

### Dam Inspections and Modifications

<table>
<thead>
<tr>
<th>Client</th>
<th>Name of Dam</th>
<th>Location</th>
<th>Type of Dam</th>
<th>Height (Feet)</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama Power Company</td>
<td>Jordan</td>
<td>Alabama</td>
<td>Concrete gravity</td>
<td>125</td>
<td>5-year FERC inspection</td>
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<tr>
<td>Commonwealth Edison Company</td>
<td>Dresden</td>
<td>Morris, Illinois</td>
<td>Earthfill</td>
<td>30</td>
<td>Annual inspection</td>
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<tr>
<td></td>
<td>Dixon Hydro Project</td>
<td>Dixon, Illinois</td>
<td>Concrete gravity</td>
<td>15</td>
<td>5-year FERC inspection</td>
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<tr>
<td>Illinois Power Company</td>
<td>Vermilion</td>
<td>Oakwood, Illinois</td>
<td>Earthfill</td>
<td>75</td>
<td>Annual inspection</td>
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<tr>
<td></td>
<td>Clinton Reservoir</td>
<td>Clinton, Illinois</td>
<td>Earthfill</td>
<td>65</td>
<td>Annual inspection</td>
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<tr>
<td></td>
<td>Baldwin Reservoir</td>
<td>Baldwin, Illinois</td>
<td>Earthfill</td>
<td>56</td>
<td>Annual inspection</td>
</tr>
<tr>
<td>Northern Indiana Public Services Company</td>
<td>Norway</td>
<td>Monticello, Indiana</td>
<td>Earthfill, concrete core</td>
<td>32</td>
<td>Plans and specifications for rehabilitation</td>
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<tr>
<td></td>
<td>Oakdale</td>
<td>Monticello, Indiana</td>
<td>Earthfill, concrete core</td>
<td>45</td>
<td>Plans and specifications for rehabilitation</td>
</tr>
<tr>
<td>Pearl River Valley Water Supply District</td>
<td>Ross Barnett</td>
<td>Jackson, Mississippi</td>
<td>Earthfill</td>
<td>64</td>
<td>Annual inspection and review Phase I report</td>
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<tr>
<td>Pennsylvania Electric Company</td>
<td>Deep Creek</td>
<td>Oakland, Maryland</td>
<td>Earthfill</td>
<td>90</td>
<td>5-year FERC inspection</td>
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<tr>
<td></td>
<td>Seneca Pumped-Storage Project</td>
<td>Warren, Pennsylvania</td>
<td>Asphalt-lined earthfill</td>
<td>115</td>
<td>5-year FERC inspection</td>
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<tr>
<td></td>
<td>Piney Hydro Project</td>
<td>Clarion, Pennsylvania</td>
<td>Concrete gravity arch</td>
<td>125</td>
<td>FERC inspection; plans, specifications, resident engineering during repairs</td>
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<tr>
<td></td>
<td>Warrior Ridge</td>
<td>Petersburg, Pa.</td>
<td>Concrete gravity</td>
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<td>Safety inspection</td>
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<tr>
<td>Rochester Public Service</td>
<td>Silver Lake</td>
<td>Minnesota</td>
<td>Pile-supported concrete</td>
<td>11</td>
<td>Inspection, plans, specifications for rehabilitation</td>
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<tr>
<td></td>
<td>Lake Zumbro</td>
<td>Minnesota</td>
<td>Concrete gravity</td>
<td>60</td>
<td>Inspection, plans, specifications for rehabilitation</td>
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<tr>
<td>South Carolina Public Service Authority</td>
<td>Santee-Cooper</td>
<td>South Carolina</td>
<td>Earthfill</td>
<td>48</td>
<td>5-year FERC inspection</td>
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<tr>
<td>South Carolina Electric and Gas Company</td>
<td>Saluda River</td>
<td>Irmo, South Carolina</td>
<td>Earthfill</td>
<td>211</td>
<td>5-year FERC inspection</td>
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<tr>
<td></td>
<td>Stevens Creek</td>
<td>Martinez, Georgia</td>
<td>Concrete gravity</td>
<td>29</td>
<td>5-year FERC inspection</td>
</tr>
<tr>
<td>Yadkin, Inc. (ALCOA)</td>
<td>Yadkin Falls Hydro</td>
<td>North Carolina</td>
<td>Concrete gravity</td>
<td>112</td>
<td>Powerhouse concrete inspection</td>
</tr>
</tbody>
</table>
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P2 The Modernization of a Small Hydro Plant
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P4 Optimal Power System Operation Analysis Techniques
P5 Evaluation of Alternatives for Electric Energy Generation
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P7 Basin Planning in the Sula Valley of Honduras
P8 Cornell Hydro Plant Redevelopment
P9 Regional Studies for Underground Energy Storage Development
P10 Optimization of Pumped-Storage Projects
P11 Potential for Conventional and Underground Pumped-Storage
P12 Electrical and Hydraulic Characteristics of Pumped-Storage Plants
P13 Pumped-Storage: Seneca and Underground
P14 Bath County, a 2100-MW Development in the USA
P15 Economic Analysis of Bath County Pumped-Storage Project
P16 Pumped-Storage Computer Control Design
P17 Computer Control Design Highlights of a Modern Hydro Power Plant
P18 Transient Analysis of Variable Pitch Pump Turbines
P19 An Assessment of Penstock Design
P20 Intakes and Penstocks of Reza Shah Kabir (arch dam)
P21 A Bellmouth Shaft Spillway with a Siphon
P22 Frame Analysis by Moment Distribution Including Shear Transformation
P23 Flow-Induced Trashrack Vibration
P24 Guri Power Complex
P25 Guri Power Complex Generators
P26 Guri Power Complex Installation and Operation

P27 Raising Guri Dam: Stability and Stress Investigations
P28 Spillway and Tailrace Design for Raising of Guri Dam Using Large Scale Hydraulic Model
P29 Transient Seepage Analysis of Guri Earthfill Dam by Finite Element Method
P30 Guri Project—Floating Bulkhead Design
P31 Evaluation of Embankment Dams by Finite Element Methods
P32 Investigations of the Guri Embankment Dams Under Seismic Loading
P33 Application of Elasto-Plastic Analysis in Rock Mechanics by Finite Element Method
P34 Some Practical Considerations for the Static and Dynamic Safety of Embankment Dams
P35 Dispersive Soils as Used in Construction of Ullum Dam in Argentina
P36 Techniques Developed During Foundation Treatment of Ullum Dam Constructed of Dispersive Soils
P37 Investigation and Repair of Hoist Dam
P38 Judgment Factors in Inspection of Dams
P39 Petenwell-Castle Rock Twenty Years Later
P40 Gas-Insulated Switchgear Solves Difficult Problems at Hydro Plants
P41 Hydroelectric Power Plant Computer Control, Installation and Start-Up
P42 Reliability Information for Electric Utility Transmission and Distribution Systems
P43 Utility Interface Requirements for a Solar Power System
P44 Coal-by-Wire
P45 A Description of Discrete Supplementary Controls for Stability
P46 Transmitting 7000 MVA through Five Double Circuit 765 kV Lines
P47 Deep Tunnel Technology
P48 Chicago’s TARP Solves Problems in Big Way
P49 Control and Monitoring of a Unique Wastewater System
P50 Nonradioactive Wastewater Treatment at the Zion Nuclear Station
P51 Wastewater Management Program for Will County Fossil-Fueled Station
P52 Development of Water Management Plan for Proposed Copper Mountain (Uranium) Project
P53 Report on Cement-Bentonite Slurry Trench Cutoff Wall for Tilden Tailings Project
P54 Design and Construction of an Embankment Dam to Impound Gypsum Waste

P55 Two-Dimensional Heated Jets in Shallow Water
P56 Nutrient Removal from Drainage Waters with Systems Containing Aquatic Macrophytes
P57 Mathematical Model of Border Irrigation
P58 Evaluation of Alternatives in Selection of Sites for Surface Water Impoundments
P59 Engineering Services in Developing Countries
P60 Development of Plans and Specifications
P61 Human and Institutional Aspects of (Irrigation) Project Formulation
P62 Water Resources Education Requirements of Engineering Firms

Harza Technotes
T1 Considerations in Planning Urban Drainage Projects
T2 Treatability Studies for Combined Paper Mill and Municipal Wastewater
T3 Industrial Wastewater Treatment . . . The Will County Generating Station
T4 Groundwater Protection . . . Possible Contamination from a Coal-Fired Generating Station
T5 Comprehensive Ground Control Study of a Mechanized Longwall Operation
T6 Industrial-Domestic Water Supply for Bauxite Mining Complex in Africa
T7 Mine-Related Groundwater Study in Wyoming
T8 Fifteen Miles of Coal Conveyor for Gavin Power Development in Ohio
T9 Tailings Impoundment Expansion Using Waste Gypsum for Construction
T10 Technical Identification of Alluvial Valley Floors for OSM Permits
T11 Treatment of Overflow from Tilden Tailings Reservoir
T12 Planning Studies for Proposed Uranium Mine in Wyoming
T13 Conceptual Design and Permitting Completed for New Elkhart Coal Mine in Illinois

Brochures Describing Harza’s Services
B1 Water Resources Planning
B2 Dams
B3 Hydroelectric Power Plants
B4 Industrial Waste Management
B5 Environmental and Permitting Assistance
B6 Transmission Systems
B7 High Voltage Substations
B8 Tunnels & Underground Structures

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