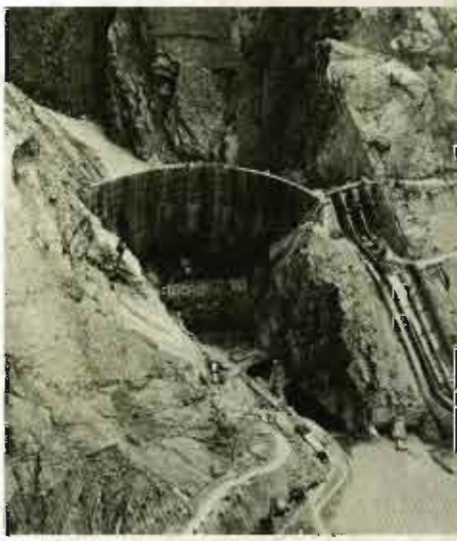
ALASKA POWER AUTHORITY
ANCHORAGE, ALASKA

PLAN OF STUDY

FOR
PROJECT FEASIBILITY AND
FERC LICENSE APPLICATION

VOLUME III - SUPPLEMENTAL INFORMATION

SUSITNA HYDROELECTRIC PROJECT



HARZA ENGINEERING COMPANY

SEPTEMEBER 1979

VOLUME III
SUPPLEMENTAL INFORMATION

INTRODUCTION

This volume presents experience resumes of personnel involved in the studies. This volume is divided in three parts as follows:

A: Harza-CH2M HILL (Multi-disciplined Planning)

B: Woodward-Clyde Consultants (Seismic Geology and Seismology)

C: Fluor Power Services (Alternative Thermal Generation)

RESUMES

Following is a list of proposed personnel and their positions for the study. Resumes are included in alphabetical order.

Position	Name
Corporate Sponsor	R. D. Harza
Project Manager	D. L. Glasscock
Review and Advisory Board	
Planning and Engineering	K. E. Sorensen
Environmental	B. J. Gallagher
Public Information	R. S. Ivey (CH2M HILL)
Project Engineer	R. L. Meagher
Senior Technical Staff	
Hydroelectric Engineering	A. E. Allen
Hydrology	R. W. Revell
Arctic Engineering	H. K. Pratt
Geology	C. L. Willis
Soils and Foundations	J. A. Scoville
Concrete Dams	R. P. Wengler
Construction	R. F. Koken
Planning and FERC Licensing	
Team Leader	L. D. Nichol
Hydroelectric Projects	K. R. Leonardson
Hydroelectric Design	E. T. Moore
Resident Planning Engineer	R. A. Zylman
Project and Basin Planning	R. C. Hundley
	L. B. Buetikofer
	R. A. Westmore
	D. Kleven (CH2M HILL)
Arch Dam Design	W. Y. J. Shieh

Mechanical Equipment	R. S. Burkhart
Electrical Equipment	J. T. Nikolas
Operation Studies	L. L. Wang
	D. J. Castellani
Transmission	J. J. Keller
System Planning	P. J. Donalek
	T. Small (CH2M HILL)
Design	R. J. Mesa
Geology	R. C. Acker
Engineering Geology	J. Q. Sims
Field Geologists	R. A. Paige
	P. A. Dickson
	A. H. Stukey
Hydrology	B-H. Wang
Streamflow	F. Damron (CH2M HILL)
Sediment	K. Jawed
Water Quality	B. K. Lee
Soils Foundations and Construction	F. D-L. Young
Materials	R. G. Oechsel
Soil Mechanics	V. Singh
Rock Mechanics	E. M. Cikanek
Concrete Structures	G. R. Mass
Construction Materials	P. S. Stoffey
Construction Engineering	B. A. Anthony
Construction Procedures	K. S. Platou

Construction Schedules	R. L. Watt
Cost Estimates	R. D. Hilliard
Economics and Finance	
Team Leader	G. V. Volland
Power Market	J. West
Alternative Sources	A. C. Vircol
Economic Analysis	E. F. Carter
Financial and Institutional Analysis	D. Sulkowski
Environmental Sciences	
Team Leader	J. H. Thrall
Aquatic Ecology	J. P. Robinson
Fisheries	J. P. Robinson
Water Quality	G. I. Bresnick
Permits	J. H. Thrall
Assessment Methodology	J. H. Thrall
Terrestrial Ecology	E. F. Dudley
Wildlife	E. F. Dudley
Vegetation	J. J. Kuruc
Forestry	J. J. Kuruc
Transmission Corridors	E. F. Dudley
Human Ecology	W. L. Partridge
Socioeconomics	S. Brody (CH2M HILL)
History/Archaeology	Outside Consultant

Cultural Resources	W. L. Partridge
Resource Inventory	R. G. Anderson
Land Use	
Remote Sensing	
Recreation	
Data Management	
Resident Engineer	H. E. Schoeller
Public Information Specialist	Alaskan Resident
Subcontract Administration	W. R. Larson

RICHARD C. ACKER
Associate and Head,
Geological Division

Degrees: Master of Science in Geology
Brown University, 1950
Bachelor of Arts in Geology
Williams College, 1947

Languages: English, Working knowledge of French and Spanish

Professional Registrations:

Professional Geologist No. 1833, California
Engineering Geologist No. 576, California

Professional Societies:

Association of Engineering Geologists
Geological Society of America

Harza Engineering Company since 1962.

Associate, 1975.
Geological Division, Head, 1973 to date; Geotechnical Division: Head, Geology Department, 1967-73; Indus Basin Division: Geologist, 1966-67; Principal Geologist and Chief, Geology and Materials Branch, West Pakistan, 1962-66.

Experience Highlights:

Responsible for the work of the Geology Division staffed with approximately twelve engineering geologists. Specific responsibilities include planning, scheduling, direction and review of geologic field and office studies and reports for variety of civil works projects. This work ranges in scope from regional appraisal studies to detailed site studies with emphasis on hydro projects, underground facilities, and related ground-water problems. Some typical projects undertaken by the division include:

Reza Shah Kabir Dam, Iran – feasibility and design investigation and studies of 650-foot high arch dam.
Nader Shah Dam, Iran – design investigations for 480-foot high rockfill dam.
St. Lawrence Basin Appraisal Studies – 18 damsites.
Blue Mountain Water Supply Project, Jamaica – appraisal and feasibility studies, diversion dams and tunnels.
Chicago North Side Rock Tunnel – feasibility investigations, 200 mile rock tunnel complex.
Patia River Basin, Colombia – appraisal of 28 damsites, prefeasibility investigation of 5 damsites, and feasibility study of 660-foot high rockfill dam.
Gavin Fly Ash Dam and Reservoir – site selection and design studies for waste retention facility.
Strontia Springs Dam, Colo. – feasibility and design studies for 300-foot high arch dam.
Uribante–Caparo Project, Venezuela – feasibility studies of four dam and tunnel complex.

RICHARD C. ACKER

Responsibilities as Principal Geologist and Chief, Geology and Materials Branch in Lahore, West Pakistan included: furnishing guidance, technical assistance and training to WAPDA group of 22 geologists performing geologic mapping, subsurface and materials investigations, and preparing geologic reports for feasibility and design of reservoir projects; reviewed geologic investigations and reports by WAPDA and various project consultants on Independent Development Works. Carried out surveillance and review of geological investigations by project consultants as liaison for Harza, Chicago, on Indus Basin projects including Mangla Dam and Tarbela Dam.

1956 to 1962:

U.S. Army Corps of Engineers; New York. N.Y.

District Geologist and assistant to Chief, Paving, Foundations and Materials Branch. Responsibilities included: All geologic work relative to siting, foundation and materials investigations, design, construction and maintenance of structures, paving and water supply for nine military airfields and a widespread rader/communications network.

1950 to 1956:

U.S. Army Corps of Engineers, Baltimore, Maryland.

District Geologist. Responsibilties included: All geologic work in planning, design and construction of dams and flood control structures; and in foundation design and construction of various military installations; investigations for mineral resource evaluation in inundation areas.

1947 to 1950:

Brown University; Providence, Rhode Island.

Graduate Teaching Assistant, Geology Department.

1948:

R.T. Vanderbilt, Inc.; Balmat, New York.

Geological Assistant to Mine Superintendent. Underground tremolite mining.

1945 to 1946:

U.S. Army Corps of Engineers, Ft. Belvoir, Virginia.

1944 to 1945:

U.S. Bureau of Mines; Starlake, New York.

Field Foreman of survey team and Geophysical Field Assistant for strategic minerals investigation.

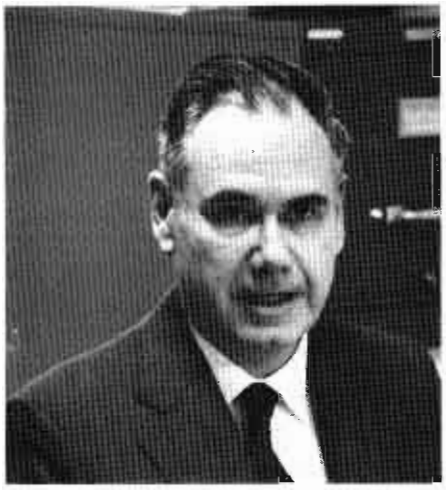
Technical Papers and Articles:

"Rock Mechanics Studies for Mossyrock Arch Dam" ASCE, Power Journal, January, 1971 co-author with D.E. Kleiner.

"Foundation and Abutment Treatment for Rockfill Dams" ASCE Journal Soil Mechanics and Foundations Division, October 1972 co-author with Jack C. Jones.

"Geologic Aspects of the Chicagoland Flood Control and Pollution Abatement Program" – paper presented at 1972 North American Rapid Excavation and Tunneling Conference. Co-author with R.S. LaRusso.

ARTHUR E. ALLEN
Vice-President and
Chief Power Development Engineer



Degrees: Master of Science in Civil Engineering
Carnegie Institute of Technology, 1939
Bachelor of Science in Civil Engineering
Carnegie Institute of Technology, now
Carnegie-Mellon University, 1938

Professional Engineer – Arizona, Illinois, New Jersey, Pennsylvania, Virginia and Washington

Professional Societies:

American Society of Civil Engineers (Fellow)
Advisory panel on research in pumped-storage, September, 1968
Power Division Committee on Hydro Power Project Planning and Design, 1969-71
Power Division Research Committee, 1974-77

Harza Engineering Company since 1960.

Vice-President, 1971; Associate, 1964.

Chief Power Development Engineer, 1977 to date; Chief Hydroelectric Engineer, 1967-77; Civil Division. Assistant Division Head, 1966-67. Planning Division: Assistant Division Head, 1965-66; Department Head, 1964-65; Section Head, 1962-64, Engineer, 1960-62.

Experience Highlights:

Project Manager for 380-MW Kinzua (Seneca) Hydroelectric Project, Pennsylvania, through planning, design, construction and start-up operations, including preparation of Original Cost Statement, F.P.C. Form 6.

Project Director for the Gavin 15-mile Coal Conveyor Civil Works, a mine water supply dam, and the Gavin and Muskingum Fly Ash Dams, Ohio, through planning, design and engineering services during construction.

Studies. Conventional and pumped-storage hydroelectric power at existing Federal dams in the Kanawha River basin, West Virginia; underground pumped-storage and surface sites in northern Illinois for Commonwealth Edison Company and in Wisconsin for the Wisconsin-Upper Michigan System, potential development of Clarion River 312-MW hydroelectric facility for Pennsylvania Electric Company; 500-MW Montezuma project for Arizona Power Authority; 240-MW Brookville project for Public Service Indiana, 525-MW Raystown site for Pennsylvania Electric Company; 2000-MW Merrimac site for Wisconsin Power & Light Company.

Analysis of 1700-MW Stony Creek project for Pennsylvania Power & Light Company and Metropolitan Edison Company. Assistance in preparation of License Application to Federal Power Commission

Analysis of 1,000-MW Mount Hope Project, underground pumped-storage and compressed-air storage, for Jersey Central Power & Light Co. Assistance in preparing license application to Federal Power Commission.

Evaluated alternate tunnel and surface routes for 10-miles of coal conveyor for American Electric Power System.

ARTHUR E. ALLEN

Review and advice on layouts for 500-MW Havasu project, Arizona Power Authority, Arizona.

Supervised studies of vibratory-induced stresses on Smith Mountain Dam and penstocks for American Electric Power System and for application to FPC for addition of a reversible pumping-generating unit.

Expert witness on hydroelectric costs for Pend Oreille County Public Utility District in suit with City of Seattle.

Compiled data and computer studies for Niagara project power operation and regulation of Lake Ontario and testified on various aspects of Great Lakes Diversion case before Special Master, U.S. Supreme Court.

Prepared FPC license applications for existing Deep Creek, Raystown and Warrior Ridge hydroelectric projects of Pennsylvania Electric Company.

Expert witness for Beaunit Fibers, Inc. for river regulation problems in Alabama.

1958 to 1960:

Non-engineering work.

1940 to 1958:

Aluminum Company of America.

Assistant Chief Power Engineer. Hydroelectric planning, design, and operation related to industrial power use.

Experience Highlights:

Studies,preliminary designs and hydraulic design for numerous hydroelectric dams for aluminum smelting facilities.

Prepared license applications to FPC for power facilities, testified in FPC hearings.

Assisted company officials in negotiations of power contracts with other utility systems.

1941 to 1945:

U.S. Army, Chemical Warfare Service. Railroad operation and track construction.

1939 to 1940:

U.S. Army Corps of Engineers, Pittsburgh District Junior Engineer. Hydroelectric computations and model studies for design of spillways for dams and flood channel improvements.

As student, summer experience with Hydraulic Research Laboratory, Carnegie Institute of Technology, Madden Dam sluices and Tionesta Dam Spillway.

HARZA ENGINEERING COMPANY

ROGER G. ANDERSON
Acting Head, Earth Sciences Department

Degrees: Master of Science in Forest Ecology/Remote Sensing
University of Illinois, 1979
Bachelor of Science in Forestry/Outdoor Recreation
University of Michigan, 1971

Languages: English and French

Professional Societies:

American Society of Photogrammetry
Society of American Foresters

Harza Engineering Company since 1972.

Environmental Sciences Division: Acting Head, Earth Sciences Department, 1979 to date, Recreation Planner, 1972-78.

Experience Highlights:

Supervised analysis of the surface characteristics of the 89,000-sq km Caroni River Basin above Guri Dam, Venezuela, using remote sensing techniques for reference in developing computer models for streamflow forecasting.

Project Manager for engineering and environmental studies for a water supply intake structure and pipeline for an electric utility company in Illinois.

Assistant Project Manager, siting studies for nuclear and fossil-fueled electric generation in northern Indiana. Responsible for an assessment of the effects of management decisions concerning reservoir surface levels on recreation facilities and visitor use and for a visual resource inventory and impact analyses. Directed the activities of aquatic and terrestrial ecologists for related environmental assessments.

Provided an appraisal of potential impacts of reservoir development on tropical forest resources for the Upper Mazaruni Hydroelectric Project in Guyana, South America.

Project Manager, Great Lakes-St. Lawrence Seaway Navigation Season Extension Demonstration Program. Responsibilities included preparation of technical reports, including the fiscal year of 1976 Environmental Impact Statement.

Developed alternative conceptual plans and preliminary design for water-based recreational development at the Bath County Pumped-Storage Project, Virginia.

Participated in all phases of recreation planning for the LaSalle County, Illinois, Nuclear Station Cooling Lake, from initial assessment of recreation potential through detailed site planning and design.

Provided alternative concepts for reclamation of strip-mined lands for recreational development at the Braidwood Nuclear Generating Station Cooling Lake.

ROGER G. ANDERSON

Developed environmental assessments and impact analyses for several water resources development projects, including the Garrison Diversion Unit in North Dakota (including interim project management); flood control measures in Webster City, Iowa; and the Stony Creek Pumped-Storage Project in Pennsylvania.

1971 to 1972:

City of Geneva, Illinois.

Assistant to City Forester. Responsibilities included all phases of municipal forestry programs.

BRIAN A. ANTHONY
Associate and Head,
Construction Management Division

Degree: Bachelor of Civil Engineering
University of Sydney, Australia, 1957
Continuing Education.
Graduate courses in Construction Management and Business Administration at University of Alberta and University of British Columbia

Languages: English, some Spanish and French

Professional Engineer — Province of British Columbia, Canada and Province of Saskatchewan, Canada

Professional Societies:

American Society of Civil Engineers
Canadian Society of Civil Engineers
Engineering Institute of Canada
Institute of Engineers of Australia

Harza Engineering Company since 1971:

Associate, 1976.

Head, Construction Management Division, 1978 to date; Executive Manager, Harza Engineering Company International, 1973-77; Resident Engineer, 1971-77.

Experience Highlights:

Head of Construction Management Division in Chicago office. Responsible for management of all construction engineering, construction scheduling, construction inspection, contracts administration, specifications and estimating, technical procurement, field liaison, and resident engineers.

Resident Engineer on the construction of the Reza Shah Kabir Project in Iran. Responsible for the project management of seven major contracts consisting of a 200 meter high concrete arch dam, a 1000-MW powerhouse and a switchyard.

Resident Manager for Iran concerned with new business development other than on the Karun and Marun Projects.

Chief Resident Engineer for all Harza Engineering Company International (HARZINT) construction work in Iran. Projects consisted of the 200-meter high concrete arch Reza Shah Kabir Dam, the 170-meter high rockfill Nader Shah dam, and the 22-meter high Gotvand Diversion Dam, the 42,000-hectare Gotvand and the 15,000-hectare Behbehan Irrigation Projects; and 884.9 kilometers of a 400-kV transmission line and four 400-kV substations.

BRIAN A. ANTHONY

1964 to 1971:

Montreal Engineering Company Limited, Montreal, Quebec, Canada.

Resident Engineer. Assigned to the TRIUMF 500-Me V Cyclotron at the University of British Columbia. Responsible for the civil construction, supervision, contract administration and client relations for the construction of the Cyclotron facility.

Resident Engineer and General Construction Superintendent. Assigned to the Karachi Nuclear Power Station for the Pakistan Atomic Energy Commission. Responsible for the civil construction, supervision, contract administration and client relations on a "turnkey" construction contract for the 137-MW Candu type reactor.

Assistant Resident Engineer. Assigned to the Charuroqui Power Development, Bolivia. Supervised the construction of headworks, pressure tunnel, penstock and powerhouse, including installation of turbines and generators for the 13-MW units.

Resident Engineer. Site investigations for Kraft Pulp Mill, Nova Scotia, Canada.

1961 to 1964:

Sverdrup and Parcel International, Inc., St. Louis, Missouri.

Powerhouse Engineer. Yanhee Project, Thailand. Responsible for civil construction supervision of powerhouse and associate concrete work on the $100 million, 1-1/2 million cubic yard concrete arch dam and power plant.

1960 to 1961:

Strong, Lamb & Nelson, Regina, Saskatchewan, Canada.

Design and Resident Engineer. Assigned to oil pumping terminals, roadworks and water supply and treatment facilities in southeast Saskatchewan.

1959 to 1960:

Commonwealth Department of Works, Sydney, Australia.

Structural Design Engineer. Assigned to reinforced concrete structures for military installation.

1958 to 1959:

Metropolitan Water Sewerage and Drainage Board, Sydney, Australia.

Construction Engineer. Assigned to the 1-1/2 million cubic yard Warragamba Dam, Australia.

1956 to 1957:

Junior Field Engineer. Assigned to the construction of two 300,000 cubic yard concrete gravity dams, Keepit and Tinarro Falls Dams for State Water Conservation and Irrigation Commissions.

GERALD I. BRESNICK
Head, Aquatic Ecology Section

Degrees: Doctor of Philosophy in Biology
Tulane University, 1975
Bachelor of Arts in Biology
State University of New York at Buffalo, 1971

Languages: English and working knowledge of German and Spanish

Professional Societies:

American Association for the Advancement of Science
American Fisheries Society
American Society of Ichthyologists and Herpetologists
American Society of Limnology and Oceanography
American Society of Naturalists

Harza Engineering Company since 1976.

Environmental Sciences Division. Head, Aquatic Ecology Section, 1978 to date; Fisheries Biologist/Limnologist, 1976-78.

Experience Highlights:

Responsibilities include design, management, and quality control of aquatic ecological investigations, assessments, and reports. Conducts resource assessments and impact analyses for both domestic and overseas projects.

Project Manager for the Williamson No. 2 Mine Project, Illinois. Supervised and directed environmental and engineering work related to coal mine reclamation and mitigation of acid mine drainage.

Conducted field reconnaissance and prepared environmental impact report for the Yacyreta Project on the Rio Parana between Argentina and Paraguay, including evaluation of biological, cultural, and economic aspects of the project area.

Assessed impacts on aquatic ecosystems resulting from the rehabilitation of Lock and Dam No. 1 on the Mississippi River, Minnesota.

Prepared a feasibility report on pumped-storage development at Bluestone Lake, West Virginia, for the U.S. Army Corps of Engineers.

Participated in an environmental assessment of the construction and operation of a proposed nuclear power plant and cooling water reservoir, Indiana.

1975 to 1976:

Tulane University, New Orleans, Louisiana.

Instructor. Taught courses in general biology, general botany, and zoology, and seminars in limnology and aquatic ecology. Conducted research on the effects of environmental factors on the growth rates of fishes.

GERALD I. BRESNICK

1972 to 1975:

Biological Consultant, New Orleans, Louisiana.

Responsible for water quality analysis and interpretation, fish collection and identification, and analysis of existing water pollution control treatment facilities with emphasis on effects of ichthyofauna. Specialized in determining and evaluating aquatic impacts of pulp and paper mill effluents and domestic sewage.

Technical Papers and Articles:

"The Ecological Life History of the Cherryfin Shiner, Notropis roseipinnis (Hay)," with D. C. Heins, Trans. Amer. Fish. Soc. 104(3), pp. 514-521, 1975.

"Age and Growth of the Weed Shiner, Notropis texanus (Girard)," with D. C. Heins, Amer. Midl. Nat. 98, pp. 495-499, 1977.

Reviewer of sections on dissolved oxygen and mixing zones, USEPA "Red Book," 1978.

"The Effects of Stream Channelization on the Life History of the Cherryfin Shiner," presented at the Annual Meeting of the Association of Southeastern Biologists, 1974.

"Environmental Evaluation Based on the Relative Growth Rates of Fishes," Ph.D. Dissertation, Tulane University, 1975.

"Tagging and Marking of Fishes," Monograph, 1973.

Author or coauthor of over 20 professional reports.

SUSAN E. BRODY
Urban and Regional Planner

EDUCATION

Master of City Planning, Massachusetts Institute of Technology, 1977
M.A., Political Science, University of California at Santa Barbara, 1973
B.A., Political Science, Reed College, 1971

EXPERIENCE

Ms. Brody is a member of the planning and economics departments, where she specializes in the areas of socio-economic impacts, policy analysis and land use planning. Her recent experience at CH2M HILL includes:

- Investigation of the social and economic impacts of offshore oil development in Alaska's Lower Cook Inlet and formulation of strategies to meet impact-related needs.
- Design of a procedures manual to help guide developers through the permit regulatory processes within Alaska.
- Evaluation of the housing, land use, and management alternatives for Beluga coal field development in the Cook Inlet region of Alaska.
- Preparation of a land use plan for the City of Seward, Alaska.
- Consulting planning to the City of Homer, Alaska.
- Assistance to the State of Oregon's Outer Continental Shelf Task Force in preparing a report on the impacts of offshore oil and gas development and recommendations for future action.

Before joining CH2M HILL, Ms. Brody participated in an MIT research project to develop policy options for state governments dealing with the social and economic impacts of energy facility siting in the western United States. During this time she also served as a consultant to the Edgartown Open Space Planning Project on the island of Martha's Vineyard, Massachusetts. This work involved natural resource mapping and an evaluation of methods for acquiring shorefront access and preserving recreational and scenic resources.

LARRY B. BUETIKOFER
Water Resources Engineer

Degrees: Master of Science in Civil Engineering (Water Resources Planning)
University of Illinois, 1973
Bachelor of Science in Civil Engineering
Syracuse University, 1971

Languages: English and Spanish

Professional Engineer — Engineer-in-Training, Illinois

Professional Societies:

American Geophysical Union
American Society of Civil Engineers
American Water Resources Association
Illinois Society of Professional Engineers
International Water Resources Association
National Society of Professional Engineers

Harza Engineering Company since 1973.

Water Resources Division: Water Resources Engineer, 1973 to date.

Experience Highlights:

Participated in water resources planning and hydrological studies. Specifically dealt with flood analyses and control, stochastic streamflow generation, drought analyses, hydroeconomics, river basin planning, site development and computer applications.

Project Manager for preparation of a flood study for the City of Janesville, Wisconsin. Water surface profiles were developed for future use in formulation of structural flood control measures and for land-use zoning.

Project Manager for Great Lakes–St. Lawrence Seaway Navigation Season Extension Demonstration Program/Survey Study. Responsibilities included coordination with the client (Detroit District, U.S. Army Corps of Engineers), attendance at Winter Navigation Board Meetings, Working Committee Meetings, and Public Meetings; Administration and coordination of Harza Project work; and report writing and preparation.

1971 to 1973:

University of Illinois.

Graduate Research Assistant, Department of Civil Engineering. Contributed to research project entitled: "Hydrologic Models of the Great Lakes."

LARRY B. BUETIKOFER

1971:

Stearns & Wheler — Civil and Sanitary Engineers.

Engineer. Worked on Madison County New York Comprehensive Water Supply Study. Primary duties included hydrological analysis, economic analysis, and report writing.

Technical Papers and Articles:

Research Papers —

"Annotated Bibliography on Great Lakes Hydrology," (with Dr. Dale D. Meredith), University of Illinois Water Resources Center, Research Report No. 56, 62 pages, September 1972.

"A Survey of Selected Rainfall Runoff Models with Emphasis on the Stanford Watershed Model" Unpublished, 92 pages, January 1972.

RICHARD S. BURKHART
Associate, Assistant Chief Mechanical Design Engineer, and Head, General Mechanical Division I

Degree: Bachelor of Science in Engineering Science
North Central College, 1959

Professional Engineer — Texas, Virginia

Professional Society:

American Society of Mechanical Engineers

Harza Engineering Company 1959-60; 1962-73; Since 1977.

Associate, 1978.

Mechanical Design Branch: Assistant Chief Mechanical Design Engineer and Head, General Mechanical Division I, 1977 to date; Department Head, 1972-73; Computer Division Head, Systems Analysis Department, 1971-72; Mechanical Division: Section Head, 1970-71; Computer Division: Production Manager, 1970, Mechanical Division. Group Leader, 1967-70; Mechanical Engineer, 1962-67; and 1959-60.

Experience Highlights:

In the absence of the Chief Mechanical Design Engineer, responsible for technical direction and administration of mechanical engineering for all projects engineered by the Company including gates, cranes, hoists, hydraulic turbines and pump turbines, governors, combustion turbines, pumping, mechanical auxiliary equipment and heating, ventilating and air conditioning.

As Division Head, direct the work of a division responsible for all general mechanical engineering work on hydroelectric powerstations, diesel and gas turbine installations, pumping plants and related projects. Major projects include the 10,000-MW Guri Final State Project, Venezuela, and the 2100-MW Bath County Pumped-Storage Project, Virginia.

Assistant Project Manager for the 1000-MW Mount Hope Underground Hydroelectric Pumped-Storage Project, New Jersey, during the feasibility study. Also responsible for all mechanical work related to studies of compressed air energy storage for the project.

As Head of the Systems Analysis Department, was responsible for all electronic computer operations of Harza using in-house equipment and a variety of leased computer equipment. Supervised preparation and operation of computer programs including hydraulic, hydrologic, statistical and structural analyses and personnel, accounting and budget analysis for internal company operations. Duties encompass provision of computer services to all divisions of the company, selection of computer equipment, and evaluating and securing new programs for outside sources as well as general administration of the department.

Supervised the field vibration testing of an arch dam and the penstocks at the Smith Mountain Pumped-Storage Project, Virginia.

Measurements Engineer for turbine model tests of 303,000 mhp Francis turbines for the Guri Hydroelectric Project, Venezuela.

RICHARD S. BURKHART

Participated in field testing of electric-hydraulic governors for the 40-MW Rio Lindo Project, Honduras.

Assistant Project Manager for a feasibility study for the National Aeronautics and Space Administration concerning the application of hydraulic turbine drives to a transonic wind tunnel.

Mechanical and Hydraulics Measurements Engineer for turbine and generator acceptance tests and load rejection tests for the Malpaso Powerhouse, Mexico.

Wrote technical computer programs in the Fortran Language. Programs written included programs for stress analysis of hydraulic turbine components; programs for turbine speed regulation and index test analysis and a program to simulate water quality for pollution studies.

Responsibilities as a Group Leader included preparation of engineering studies, design memoranda, contract drawings, and contract documents for the 100-MW Finchaa Project, Ethiopia, and the 40-MW Rio Lindo Project, Honduras. Work covered all mechanical piping systems and auxiliary equipment and portions of the work relating to hydraulic turbines, governors, valves, cranes and hoists.

1973 to 1977:

Brown & Root, Inc., Houston, Texas.

Department Senior Staff Engineer. In responsible charge of all mechanical work for the Water Supply and Heavy Civil Engineering Department. Directed mechanical design for a 160 cfs pumping station for the Manatee Powerplant and Reservoir, Florida; a 800 cfs pumping station for the Martin Powerplant and Reservoir, Florida; a 200 cfs station for the Sooner Powerplant and Reservoir, Oklahoma; a 160 cfs irrigation pumping station on the Brazos River, Texas; and a 1200 cfs pumping station for the South Texas Nuclear Project, Texas.

Served for two years as Project Manager for the $30,000,000 reservoir and pumping station for the Martin Powerplant, Florida.

1960 to 1962:

U.S. Army.

Project Engineer. Performed research and development work in dynamic testing of diesel and gasoline powered military track and wheeled vehicles and vehicle transported weapons systems. Duties included supervision of testing, evaluation of test data, and preparation and issuing of final test reports.

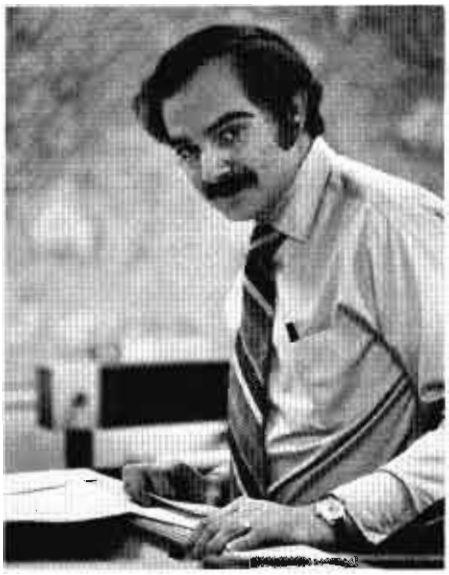
HARZA ENGINEERING COMPANY

EDWARD F. CARTER
Power Planning Engineer

Date of Birth:	February 12, 1947
Citizenship:	U. S. A.
Degrees:	Bachelor of Science in Civil Engineering, Magna Cum Laude 1976, Syracuse University Bachelor of Science in Forest Engineering, Magna Cum Laude 1975, State University of New York, College of Environmental Science and Forestry
Language:	English
Professional Registration:	Professional Engineer - Wisconsin
Professional Societies:	American Society of Civil Engineers Illinois Chapter ASCE
Honorary Society:	Tau Beta Pi
June 1976 to Date:	Harza Engineering Company, Chicago, Illinois. Power Planning Engineer. Power Resources Division. Participated in the expansion studies of the lower Susquehanna River hydro plants. Responsibilities include project layout, quantity and cost estimates, power operation computer studies and selection of optimal expansion scheme. Participated in modernization and expansion studies related to the Holtwood Hydroelectric project. Responsibilities included power and energy studies, project layout and cost estimates, economic analysis for selection of the optimum scheme and preparation of the report. Participated in economic and financial analyses for the ENEE Generation System Expansion study, Honduras, C.A. Responsibilities included forecast of expenditure schedules, determination of equalizing discount rates for various generation mixes, selection

June 1976 to Date: (continued)	of power expansion program, sensitivity analyses, effects of construction delay on recommended program, economics of rural electrification and financial justification of the recommended system expansion program. Participated in the preparation of construction plans and schedules for the rehabilitation of Lock and Dam No. 1 on the Mississippi River for the St. Paul District Corps of Engineers. Temporary assignment to the Construction Management Division, Scheduling Department, July, August and September 1977. Responsibilities included material quantity takeoffs, development of feasible construction approach and critical path method (CPM) scheduling for construction.
Summer Employment 1972 to 1975:	J.S. MacNeil Jr., Inc., Homer, New York. Assistant Technical Engineer. Responsible for construction quality control, Joseph Schlitz Brewery, Baldwinsville, New York. Vincent J. Smith, Inc., Syracuse, New York. Assistant Technical Engineer. Responsible for interpreting the architectural and structural drawings of a multi-story hospital addition and relating the information to field personnel. D.W. Winkelman, Inc., Syracuse, New York. Assistant Technical Engineer. Survey instrument work related to interstate highway route location.
February 1970 to January 1972:	Vincent J. Smith, Inc., Syracuse, New York. Assistant Technical Engineer. Responsible for interpreting the architectural and structural drawings of a multi-story library and relating the information to field personnel.
October 1966 to January 1970:	United States Navy. Petty Officer. In charge of a twelve-man survey department. Responsible for the survey portion of major construction and reconstruction projects in the Republic of Vietnam.

DANIEL J. CASTELLANI
Planning Engineer



Degrees: Master of Science in Civil Engineering
University of Notre Dame, 1965
Bachelor of Science in Civil Engineering
University of Notre Dame, 1963

Professional Engineer – Illinois

Harza Engineering Company since 1966.

Power Resources Division: Planning Engineer, 1975 to date; Head, Computer Department, 1972-75; Applied Mechanics Division: Structural Engineer, 1970-72; Computer Division: Systems Analyst, 1968-70; Engineering Programmer, 1966-67.

Experience Highlights:

Responsible for interior drainage analysis of eight leveed communities on the Souris River near Minot, North Dakota. The analysis included the design of stormwater interceptors, and the sizing of stormwater pumping stations and gravity outlets. The work was performed for the St. Paul District of the U. S. Army Corps of Engineers. In conjunction with the above project, was also responsible for the layout of the spillway and outlet works for both Burlington Dam and the Des Lacs River Diversion Dam.

Performed computer simulation of reservoir drawdown study to determine generating capacity for Reza Shah Kabir Dam, Iran.

Responsible for management of all data processing functions, including both commercial and engineering applications. In-house facilities included an IBM 1130 computer system and a Cope 1225 remote batch terminal. Experienced in Fortran programming on IBM-1130, IBM-360/195, IBM-370/158, CDC-6600 and Univac-1108.

Performed analysis and reviewed design of transmission towers for Guri Project, Venezuela; Finchaa Project, Ethiopia and CEL system expansion, El Salvador. Inspected transmission tower tests at Cheddar, England and two at Sarajevo, Yugoslavia. Performed computer tower spotting and sag-tension analysis for 2 major transmission lines.

Developed and programmed numerous computer programs including SAPLT, which checks and plots the input data for SAP, a finite element Structural Analysis Program; RDLBO, which calculates and plots the development of reducing elbows – used in designing Guri penstocks; AGEOM, which plots the geometry and shape of double curvature arch dams – used on Reza Shah Kabir Dam, Iran; KARUN, which calculates corrected stress and strain of strain gauge clusters imbedded in mass concrete; SHAFT, which calculates the resonant frequency of turbine-generator shafts. Performed all programming for "Estimating Costs of Hard Rock Tunneling" (COHART), for the U. S. Department of Transportation.

DANIEL J. CASTELLANI

1965 to 1966:

University of Notre Dame.

Completed course requirements for Ph.D. in Civil Engineering. Laboratory Instructor in the National Science Foundation Summer Institute on Structural Mechanics.

Technical Papers and Articles:

Unpublished Master's thesis submitted to the University of Notre Dame, June, 1965 – "Buckling Characteristics of Prestressed Concrete Columns."

EDWARD M. CIKANEK
Department Head

Degrees: Master of Science in Civil Engineering
University of Notre Dame, 1966
Bachelor of Science in Civil Engineering
Northwestern University, 1964

Professional Engineer — Illinois

Professional Societies:

American Society of Civil Engineers (Member)
National Society of Professional Engineers
Illinois Society of Professional Engineers
International Society for Rock Mechanics

Harza Engineering Company since 1966.

Foundation and Soil Mechanics Division: Head, Underground Projects Department, 1976 to date; Section Head, 1972-76; Group Leader, 1968-72; Engineer, 1966-68.

Experience Highlights:

Supervised foundation and embankment design studies and preparation of Corps of Engineer Design Memoranda for Calion Lock and Dam in Arkansas. Topics included structure settlement, structure and slope stability, excavation dewatering, construction material surveys and instrumentation of foundations and structures.

Supervised foundations and embankment design studies for Burlington Dam in North Dakota. Topics included dam stability and settlement, diversion tunnel design, upgrading of existing flood control levees and stabilization of existing structures.

Supervision of design studies for tunnels in rock and earth and for underground excavations in rock.

Project Manager for developing a computer program for estimating the costs of soft ground and cut-and-cover tunnels and for combining it with COHART, a computer program for estimating costs of hard rock tunneling. This formed a computer program, COSTUN, capable of estimating costs of rock, soft-ground, and cut-and-cover tunnels in a single computer run. Previously supervised design studies for, and the development of, COHART. Co-authored final reports for COHART and COSTUN.

Supervised studies to determine preliminary tunnel locations and the optimum development of surface reservoirs for the Chicago, Illinois Tunnel and Reservoir Plan (TARP). Subsequently supervised studies leading to final selection of tunnel alignment, excavation method, and lining type and developed grouting and support requirements. Prepared construction specifications and appropriate portions of final design report. Supervised similar studies and proposed specifications for two underground pump stations and related tunnels and shafts.

Supervised tunnel design studies and preparation of contract documents for the Washington, D.C. Subway, Section A-6. Topics included tunnel linings and supports, construction methods, specifications and payment methods.

Supervised Tunnel design studies for Bath County pumped-storage project.

EDWARD M. CIKANEK

Participated in the planning studies of alternative routes for a coal conveyor in Ohio, including a comparison of tunnel and surface routes.

Supervised design studies for pile foundations in Louisiana; revised and expanded a computer program for Hrennikoff's solution of pile foundations.

Performed various embankment design studies for Lake Michigan Offshore Airport. Made preliminary design studies for a 400-mile tunnel for High Speed Ground Transportation from Boston to Washington, D.C. and assisted in writing the final report. Assisted in writing Harza Guide technical specifications for fills, excavations, drilling and grouting.

Supervised foundation exploration and soil testing for the 100-MW Finchaa Project, Ethiopia.

1964 to 1966:

University of Notre Dame. Full-time graduate student pursuing course leading to Master of Science Degree in Civil Engineering.

Technical Papers and Articles:

Unpublished Master's Thesis submitted to the University of Notre Dame, June, 1966, "Porewater Pressures in Partly Saturated Sands."

"A Computer Program for Estimating Costs of Tunneling," presented to June 1974 Rapid Excavation and Tunneling Conference, San Francisco, Co-authored with Frank T. Wheby.

FLOYD J. DAMRON
Civil Engineer

Education

M.S.C.E., University of Alaska, Fairbanks, 1973
B.S.C.E., University of Alaska, Fairbanks, 1971
University of Alaska, Fish Hatchery Design, Short Course, 1976
University of Texas, Flood Plain Hydraulics and Hydrology, Short Courses, 1976
Colorado State University, Modeling of Rivers, Institute of River Mechanics, 1977
University of Iowa, Ice Engineering, Short Course, 1978
U.S. Army Corps of Engineers, Phase I Dam Safety Inspection, Short Course, 1978

Experience

Mr. Damron has served as project engineer and design engineer on a variety of hydrologic, water resource, and general civil engineering projects in Alaska. His background includes experience in: municipal water supply investigations, flood studies, flood routing, drainage studies, fish hatchery and treatment plant hydraulic design, a hatchery site study, water quality monitoring, structural design of a sheet pile dam, design of various parking lots and sidewalks, and owner's representative for construction projects.

Some typical projects on which Mr. Damron has worked are:

- Project manager for a hydrologic investigation at the proposed new capital site near Willow. Close coordination with agencies and other consultants was required for the acquisition of environmental assessment data. Extensive surface and subsurface exploration was conducted, including water well design and test pumping.

- Project engineer for 10 Flood Plain Information Reports and a major flood insurance study of coastal communities. Duties included cost estimation and contract administration, coordination of other consultants, hydrologic and hydraulic analysis by computer modeling of all riverine and lacustrine flooding, and preparation of final maps and reports. One model was unique in that dumping glacial lakes produce the principal flooding.

- Design and analysis of floodway and seepage collection channels for the Corps of Engineers' Moose Creek Dam (flood control project for Fairbanks). The floodway is designed to carry all excess flow in the Chena

River (80,000 cubic feet per second) to the Tenana River. The seepage channel design (4,000 cubic feet per second) was designed curvilinear for aesthetics and sized to prevent downstream flooding due to dam seepage during utilization of the floodway.

- Principal design engineer for the Ship Creek Hatchery, Anchorage. Responsibility included design of the hydraulic system for the hatchery. The 16-cubic-feet-per-second design included the capability of varying the temperature in each fish rearing raceway by mixing excess hot power generation cooling water with cold creek water. As principal design engineer on a subsequent study for expansion of the hatchery, responsible for detailed analysis of the stream flow, augmentation of flow with shallow wells, water reuse, existing system modification, and shallow well injection of excess power plant cooling water for later use.

- Drainage engineer for Anchorage International Airport North-South runway project. Responsibility included the establishment of design flows and pipe sizing for the collection system. Design flow of the outfall exceeds 100 cubic feet per second.

- Owner's representative for a North Slope winter construction project which included the rehabilitation of a landing strip, seven miles of ice road construction, and excavation and placement of 40,000 cubic yards of gravel for a drilling pad. Environmental protection was closely monitored throughout the project.

Professional Registration

Alaska

Membership in Organizations

Alaska Ground Water Association
Alaska Society of Professional Engineers
American Society of Civil Engineers
National Society of Professional Engineers

Publications

"Water/Wastewater Evaluation of an Arctic Alaskan Industrial Camp," University of Alaska, 1972

PETER A. DICKSON
Geologist

Degrees: Doctor of Philosophy in Geology
University of Pittsburgh, Pennsylvania, 1977
Master of Science in Geology
University of Manchester, England, 1974
Bachelor of Science in Geology
University of Leeds, England, 1971

Languages: English, French, and knowledge of German and Turkish

Professional Societies:

Geological Society of America
International Paleontological Union
Paleontological Society

Harza Engineering Company since 1978.

Geologist, Geology Division, 1978 to date.

Experience Highlights:

In Chicago office, assists in preparation of exploration programs and interprets regional and site structural geology for Jordan Valley Irrigation Project, Maqarin Dam Site. Works on petrography, clay mineralogy, paleontology, and general geological studies of the project site, including LANDSAT imagery and writing of reports. Instrumental in construction of a three-dimensional model of the site geology.

Resident Field Geologist for prefeasibility investigations, Brumley Gap and Powell Mountain Pumped-Storage Projects, Virginia (March to November 1978). Responsibilities included regional and site mapping of stratigraphy and structure, preparation of field reports and geologic sections, and investigation of karstic land surfaces. Assisted in preparation of exploration programs, including a literature search of the region's geology.

1977 to 1978:

Gulf Research and Development Company, Pittsburgh, Pennsylvania.

Geological Field Consultant. Collected and interpreted detailed structural and stratigraphic data as part of a LANDSAT research project.

1975 to 1977:

University of Pittsburgh, Pittsburgh, Pennsylvania.

Research Assistant and Teaching Fellow in Geology. Research involved stratigraphic and petrologic investigation of coal-bearing rocks in Appalachian coalfield region, including coal petrography and field mapping.

PETER A. DICKSON

1971 to 1975:

University of Manchester, England.

Research Assistant to Dr. R. M. C. Eagar. Studies included geologic field work in cooperation with various State Geological Surveys and coal companies, in the coalfield regions of England, Wales, northwest Spain, the Appalachian Mountains, and Illinois. Responsibilities included detailed stratigraphic and petrologic interpretation from core log and field data, and field mapping.

1967 to 1971:

University of Leeds, England.

Graduate Student.

PETER DONALEK
Electrical Engineer

Degrees: Master of Arts – Mathematics
University of Toledo, 1973
Master of Science in Electrical Engineering
University of Pennsylvania, 1970
Bachelor of Science in Electrical Engineering
University of Illinois, 1961

Languages: English, speaking and reading knowledge of Portuguese, and reading knowledge of French.

Professional Engineer – Illinois

Professional Societies:

Institute of Electrical & Electronics Engineers
Chairman, Task Force on Discrete Supplementary Controls for Stability
Society for Industrial and Applied Mathematics
The Mathematical Association of America
Western Society of Engineers

Harza Engineering Company since 1973.

Senior Electrical Engineer, 1974 to date; Electrical Engineer, 1973-74.

Experience Highlights:

Project Manager for a study and report on technical and economic feasibility of coal mine-mouth generation and a 765-kV transmission network in the United States.

Project Manager for a study and report for electric utility interface requirements and siting of solar power satellite, 5,000-MW rectifying antennas.

Directed a transient network analyzer study for 500-kV transmission line in Pakistan.

Project Manager on the evaluation of transmission system expansion for the State of Montana.

Designed load shedding system for El Salvador bulk power transmission system.

Planned for expansion of power transmission system in El Salvador.

Prepared specifications for oil minimum circuit breaker.

Evaluated a battery system as an alternative to pumped-storage hydro for use in Federal Power Commission license application.

Prepared load flow, short circuit, and stability computations used in developing a twenty-five year system expansion plan for the Republic of South Korea.

Prepared preliminary cost estimates for the electrical portion of various pumped-storage and hydroelectric generating stations.

PETER DONALEK

Prepared cost estimates for various high voltage substations.

Prepared alternative electric systems and auxiliary electrical equipment for pumping stations, including studies of motor starting methods for the Chicago Tunnel and Reservoir Project.

1971 to 1973:

University of Toledo, Toledo, Ohio.

Graduate Teaching Assistant. Worked on Masters degree in mathematics and taught undergraduate mathematics courses.

1969 to 1971:

Spring Garden College, Philadelphia, Pennsylvania.

Assistant Professor. Taught introductory courses in electromechanics and electrical power systems. Was in charge of the A.C. Network Analyzer.

1965 to 1968:

Sargent & Lundy Engineers, Chicago, Illinois.

Electrical Engineer. Performed electrical power system design studies. Prepared economic comparisons of alternative power plant expansion plans, and analysis of substation short circuit and relay problems.

1963 to 1965:

United States Peace Corps, Brazil.

Electrical Engineer and Designer for rural electrification projects in the San Francisco River Valley. The work was done in conjunction with the Brazilian government agency Comissao do Vale do Sao Francisco, similar to the U. S. Bureau of Reclamation.

1961 to 1963:

Westinghouse Electric Corporation, Baltimore, Maryland.

Field Service Engineer. Part of a group responsible for the re-design of the radar system used in U. S. Navy aircraft.

EUGENE F. DUDLEY
Senior Ecologist

Degrees: Doctor of Philosophy in Wildlife Management
University of Michigan, 1963
Master of Science in Zoology (Ecology)
University of Michigan, 1954
Bachelor of Science (Zoology)
Yale University, 1953

Professional Societies:

International Water Resources Association
Illinois Association of Environmental Professionals
The Wildlife Society

Civic Activities:

Vice Chairman, Planning and Zoning Commission of home community

Harza Engineering Company since 1970.

Environmental Sciences Division: Senior Ecologist, 1974 to date; Ecologist, 1970-74.

Experience Highlights:

Organize and supervise evaluations of potential effects of water and land developments on ecologic systems and natural resources. Review compliance of existing and proposed developments with the National Environmental Policy Act and guidelines established by international financing agencies. Prepare Environmental Assessment and Impact Reports.

Project Manager of studies of environmental impact and recreation potential of nuclear power installations, reservoirs built for nuclear and fossil fuel power plant cooling, hydroelectric power generation, irrigation, flood control, and municipal and industrial water supply, and of non-structural measures for land and water management. Managed and had overall responsibility for environmental inventories, assessments, and impact evaluations for more than twenty projects. Experience includes the evaluation of impacts on the terrestrial and aquatic environment, aesthetics, existing and potential recreation opportunities, access, social and cultural characteristics, and public health and safety.

Environmental coordinator for the 2,700-MW Yacyreta Hydroelectric Project on the Rio Parana, Argentina and Paraguay. Impacts and resource development opportunities were evaluated in accordance with policies of the World Bank and the Interamerican Development Bank. Special attention was devoted to ecologic impacts on endangered species, fishery resources and water quality, and to social impacts, including the resettlement of approximately 30,000 residents. Long-term programs were formulated for water quality management, fishery production, natural preserves, and regional land use planning.

Prepared Exhibit W (Environmental Report) for FERC license application for the installation of a fourth unit of the Mayfield hydroelectric station, Cowlitz River, Washington. Prepared analyses of effects on fisheries and riparian resources resulting from changes in project outflows. Assisted the City of Tacoma in a series of meetings with

the fishery agencies to establish acceptable high and low flows and in the preparation of reports to the agencies and FERC. Local and agency concerns and actual physical and biological conditions in the project area were integrated into a program that was ultimately acceptable to all parties.

Conducted environmental inventories and impact assessments for alternative measures for reduction of local flood damage at Webster City, Iowa. Similar investigations were performed for a project at Fredericksburg, Virginia, where certain alternatives would affect estuarine waters.

Provided environmental assessments for alternatives identified in power plant siting surveys in Wisconsin, Michigan, Maryland, and West Virginia.

Performed and coordinated field investigations and assessments of impacts on freshwater and estuarine marsh resulting from agricultural development in Jamaica.

Other assignments have included analyses of environmental impacts of water resource development projects, and planning for pollution abatement, recreation, fisheries, and other enhancement measures on projects in the United States and overseas. Typical projects included the multipurpose Northside development project, Washington; Springer Lake Project, Illinois (independent review for University of Illinois); irrigation developments in Jordan and Guyana; and hydroelectric projects on the Chimbo River, Ecuador, Patia and Sogamoso Rivers, Colombia, the Mazaruni River, Guyana, the Lempa River, El Salvador, and the Bermejo River, Argentina.

1967 to 1970:

Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Boston, Massachusetts.

Fish and Wildlife Biologist. Staff Biologist, Division of River Basin Studies, Chief of Section of Special Studies.

Reviewed the impact on environmental quality and natural resources of hydroelectric and atomic power facilities and watershed developments for flood control, navigation, and other water related activities.

1961 to 1967:

Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, Michigan.

Research Associate in Epidemiology, Ecologist for the Tecumseh Community Health Study, Center for Research in Diseases of the Heart, Circulation, and Related Disorders.

Studied the relationships between the biological and physical environment and human health. Factors considered included vegetation and land use, fauna, climate, and human and animal diseases.

Technical Papers and Articles:

"Climate, Water Hardness, and Coronary Heart Disease," with R. A. Belden, and B. C. Johnson, Journal of Chronic Diseases 22 (1) pp. 25-48, 1969.

"Environmental Aspects of Site Selection," ASCE Power Division Journal, pp. 21-28, June 1972.

"Petenwell-Castle Rock, Twenty Years Later," with W. T. Bristow, prepared for the 11th ICOLD Congress, Madrid, 1973.

BRIAN J. GALLAGHER
Associate and
Head, Environmental Sciences Division

Degrees: Doctor of Environmental Science and Engineering
University of California, Los Angeles, 1977
Master of Science in Civil Engineering (Water Resources)
University of Wisconsin, Milwaukee, 1972
Bachelor of Science in Mathematics and Physics
University of Wisconsin, Milwaukee, 1967

Languages: English and working knowledge of Spanish and German

Professional Engineer -- Wisconsin

Professional Societies:

American Society of Civil Engineers
American Society of Limnology and Oceanography
International Water Resources Association

Harza Engineering Company since 1977.

Associate, 1979.

Head, Environmental Sciences Division, 1977 to date.

Experience Highlights:

Supervises interdisciplinary team of scientists, engineers, and planners conducting resource investigations, ecosystem analyses, and environmental impact assessments. Responsible for overall direction of regulatory and permitting assistance to clients on resource development projects both domestic and international.

Project Director for southern Illinois abandoned coal mine/acid drainage control and reclamation project, 1978-79. Directed and reviewed all studies, reports, and recommendations, and represented client before regulatory agencies for plan approvals.

Acting Senior Professional Staff reviewer on water availability assessments and water quality analyses for the "Upper Missouri River Basin Coal Development Scenarios," including advanced coal conversion technologies, 1978.

Directed in-house development of computerized program management system for similarity, scheduling, and control of multidisciplinary tasks involved with resource development projects and permit and license acquisitions, 1978-79.

1976 to 1977:

Principal of own firm providing environmental consulting services to industry and governmental agencies. Principal Investigator on applied research contract for U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, on design of dredged material sedimentation basins and discharge structures. Director and principal author of EPA facility planning projects (201 studies) for major wastewater collection and treatment projects in Michigan. Served as special advisor on water quality modeling of the Morava River in Yugoslavia for a United Nations Development Program.

BRIAN J. GALLAGHER

1975 to 1976:

University of California, Los Angeles, California.

Research Fellow. Conducted interdisciplinary research of Sierra Mountains Alpine Lakes water quality, offshore oil development environmental impacts, and environmental effects of coal gasification residual waste disposal.

1968 to 1975:

Limnetics Incorporated, Milwaukee, Wisconsin.

President and Chief Executive Officer of an environmental consulting firm providing professional services to electric utilities, fossil-fuel development industries, and governmental agencies. Designed and directed major ecological studies of municipal and industrial discharges, cultural eutrophication, recreational area development, thermal effects from power plant operations, artificial cooling lakes, and environmental impacts of oil shale development projects.

1959 to 1967:

General Motors Corporation, AC Electronics Division, Milwaukee, Wisconsin.

Senior Project Engineer. Systems engineer responsible for development, testing and integration of inertial guidance, radar navigation, and radiometric sextant components for aerospace and marine vehicles.

1958 to 1959:

Hughes Aircraft Company, Culver City, California.

Electronics Instructor. Taught courses on integrated fire control and navigation avionic systems.

Technical Papers and Articles:

Editor of "Energy Production and Thermal Effects," Ann Arbor Science Publishing Company, 1973.

Author and coauthor of over 20 publications and professional reports on environmental matters, including the following

"Investigation of Containment Area Design to Maximize Hydraulic Efficiency of Confined Disposal Areas," Final Report, U.S. Army Corps of Engineers Research Contract No. DACW39-76-C-0124, Waterways Experiment Station, Vicksburg, Mississippi, 1978.

"Environmental Effects of Coal Gasification," IWRA, Proceedings of the International Symposium on Fossil Fuel Production and Water Resources, Dusseldorf, Federal Republic of Germany, 1976.

"Water Quality Effects of a Dredgings Disposal Area," with R. J. Krizek and G. M. Karadi, Journal of the American Society of Civil Engineers, Environmental Engineering Division, Vol. 102, No. EE2, pp. 389-409, April 1976.

DWIGHT L. GLASSCOCK
Vice President and Head,
Hydroelectric Design Branch

Degrees: Master of Science
University of Illinois, 1947
Bachelor of Science in Civil Engineering
University of Illinois, 1944

Professional Engineer – California, Connecticut, Illinois, Maine, Maryland, Massachusetts, Michigan, Nebraska, New Hampshire, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Virginia, Wisconsin, and Nova Scotia

Professional Societies:

American Society of Civil Engineers
American Consulting Engineer Council
Newcomen Society in North America
U.S. Committee on Large Dams

Harza Engineering Company since 1978.

Hydroelectric Design Branch: Vice President and Head, 1978 to date.

Experience Highlights:

Responsible for the design of hydroelectric projects, primarily in the United States.

1952 to 1977:

Chas. T. Main, Inc., Boston, Massachusetts.

Hydroelectric Power and Water Resources Division: Vice President, General Manager, 1971-77; Project Manager, 1964-71; Project Engineer, 1958-64; Design Engineer, 1952-58.

Responsible for the technical design activities, construction management, project staffing, work scheduling, and performance of the project teams of the division. The scope of engineering services provided by the division covered reconnaissance studies, feasibility studies, all disciplines of detailed design, construction management, and start-up operation. Operations included both domestic and international projects with work undertaken concurrently in the U.S., South America, Africa, and Asia.

Responsible for the direction, coordination, and execution of design for the 1,000-MW Blenheim-Gilboa Pumped-Storage Development, New York State.

Directed feasibility study for the trans-basin diversion of the Capivari River for augmentation of the Sao Paulo, Brazil, water supply. Responsible for liaison and administration of Rio de Janiero and Sao Paulo, Brazil, offices of the company for the design of the 1,400-MW Marimbondo and 1,380-MW Agua Vermelha Hydroelectric Projects.

DWIGHT L. GLASSCOCK

Responsible for design and construction management for the Alternating Gradient Synchroton Conversion Project, Brookhaven National Laboratory. This complex involved facilities for high energy physics research and included buildings, shielding, and mechanical and electrical services.

Supervised a study for the regulation of the outflow of Lake Ontario which reviewed the existing regulating scheme and investigated alternative regulation plans, to determine the economic effect on the power generating facilities of the St. Lawrence Power Project, U.S. and Canada.

Responsible for the economic studies and analyses in conjunction with the comprehensive review and preparation of the engineering feasibility report for the California Water Plan. This plan provided for the conservation of northern California water and its transportation to the Central Valley and southern portion of the state.

Directed a power study for the Province of Nova Scotia, Canada, that included a forecast of load growth, power transmission and interconnections studies, rate studies, and recommendations for additional generating and transmission facilities.

Prepared flow analyses and equipment specifications, and supervised preparation of construction drawings and installation of filter plant, pumping plant, and sewer system.

Designed laboratories and process system using liquid metal for heat transfer, CANEL Project, Nuclear Aircraft Program.

Participated in feasibility studies for various municipal, public authority, and private power systems.

1949 to 1952:

Louisiana State University, Baton Rouge, Louisiana.

Assistant Professor of Hydraulic Engineering.

1947 to 1949:

Aluminum Company of America, Pittsburgh, Pennsylvania.

Hydraulic Design Engineer. Worked on structural and hydraulic design of dams, penstocks, hydroelectric power plants, and appurtenances.

RICHARD D. HARZA
President

Degrees: Master of Science in Civil Engineering
Northwestern University, 1947
Bachelor of Science in Mechanical Engineering
Northwestern University, 1944

Languages: English, working knowledge of French

Professional Engineer – Alaska, Arizona, District of Columbia, Illinois, Indiana, Iowa, Michigan, Mississippi, Ohio, Pennsylvania, Virginia, and Washington.

Civil Engineer – California

Structural Engineer – Illinois

Professional Societies:

American Institute of Consulting Engineers
American Society of Civil Engineers
American Water Resources Association (Past President)
Consulting Engineers Association of Illinois
Consulting Engineers Council
Illinois Society of Professional Engineers
National Society of Professional Engineers
United States Commission on Large Dams (Past Chairman)

Harza Engineering Company since 1947.

President, 1977.

Vice-President, 1953.

Director, Administrative, Financial, & Corporate Operations, 1976 to date; Director, Management Group II, U.S.A. Resources, 1970-76; Civil Engineer, 1947-53.

Experience Highlights:

Project Director of various projects including Deep Tunnel Plan, Lawrence Avenue Sewer System, and Lake Michigan Airport appraisal study for the City of Chicago; Root, Fox, and Milwaukee River Watersheds comprehensive plans for Southeastern Wisconsin Regional Planning Commission; Kinzua Pumped-Storage Project, Pennsylvania; and numerous smaller projects and studies.

Responsible for preparation of proposals, negotiations, and contracts for engineering services.

Concrete inspector for 20-MW Petenwell Project, Wisconsin; and Investigations Engineer for Meric-Evros Project in Greece and Turkey.

RICHARD D. HARZA

1946 to 1947:

Northwestern University, Civil Engineering Department.
Instructor.

1945 to 1946:

Ensign, USNR, deck officer on escort aircraft carrier.

Technical Papers and Articles:

Written and presented various papers on practice of consulting engineering, hydroelectric projects, and pumped-storage projects for ASCE proceedings and elsewhere.

ROBERT D. HILLIARD
Assistant Head, Construction Management Division
Head, Cost Estimating Department

Degree: Bachelor of Civil Engineering
Clarkson College of Technology, 1948

Professional Engineer -- Florida, Illinois, New Jersey, and New York

Professional Land Surveyor -- Florida

Professional Society:

American Society of Civil Engineers

Harza Engineering Company, 1966-68. Since 1976.

Construction Management Division: Assistant Head, 1978 to date; Head, Cost Estimating Department, 1977 to date; Senior Construction Engineer, 1976; Office Engineer, 1966-68.

Experience Highlights:

Division activities include preparation of contract documents, cost estimates, construction planning and scheduling, construction inspection, contract administration, and technical procurement.

Project Manager during initial organization phases for construction management services for the $500 million Mainstream Tunnel Project, Chicago, Illinois.

As Department Head, responsible for preparation of all construction cost estimates, evaluating bids on construction contracts, and making recommendations for award. Prepared a detailed cost estimating procedure manual for company use. Responsible for bid evaluation for the $1.2 billion Guri Dam Final Stage Project, Venezuela.

As Senior Construction Engineer, was involved in all aspects of construction planning, engineering inspection, scheduling, and cost estimates for the construction phase of projects.

As Office Engineer, was responsible for all field office operations in connection with construction of the Seneca (Kinzua) Pumped-Storage Plant, Pennsylvania, including contractual correspondence and claims, payment estimates, review of shop drawings, reports, schedules, and budgets.

1974 to 1976:

Gordon H. Ball, Inc., McLean, Virginia.

Senior Estimator. Prepared bid estimates for heavy construction projects including tunnel, dam, subway, and bridge jobs. Responsibilities included all phases of estimate from site investigation to bid preparation.

1974:

Morrison-Knudsen Company, Boise, Idaho.

Project Engineer. Duties included all project engineering functions on excavation of Washington, D.C., subway tunnel using a tunnel boring machine.

ROBERT D. HILLIARD

1970 to 1974:

Tippetts-Abbett-McCarthy-Stratton, New York, New York.

Deputy Resident Engineer. Supervised and inspected construction; responsible for payment estimates, contractual correspondence, claims, and change orders for the intakes, outlets, tunnels, and gate shafts of Tarbela Dam, Pakistan. Features included four 45-foot diameter power and outlet tunnels totaling 10,000 feet in length, four 41' x 67' gate shafts 350-feet deep, over six miles of small diameter tunnels and adits together with massive gated intake and outlet structures. Total quantities included approximately 1.7 million cubic yards of concrete, 500,000 cubic yards of which was underground, and over one million cubic yards of underground excavation.

1968 to 1970:

Ebasco Services, Inc., New York, New York.

Construction Engineer. Prepared design layouts for construction facilities including utilities, trestle formwork and batch plant for Ludington, Michigan, pumped-storage plant. Supervised and inspected construction of a 530-foot double curvature arch dam and a 309-MW powerplant at Gokcekaya, Turkey.

1960 to 1966:

Wiggins, Keith and Hilliard, Ft. Lauderdale, Florida.

Partner. Responsible for all engineering work in an engineering and surveying firm, including design and supervision of construction of streets, drainage, water and sewage treatment plants and systems, sea walls, groins, and docks.

1952 to 1959:

J. A. Jones Construction Company, Charlotte, North Carolina.

Project Engineer. Assigned to the construction of the 500-foot rockfill Derbendi Khan Dam, Iraq; the 120-foot concrete gravity Green Lane Dam, Pennsylvania; and 12 miles of the Ohio Turnpike.

Cost Engineer on the Old Hickory Lock and Dam, Tennessee.

1950 to 1952:

A. S. Wikstrom, Inc., Skaneateles, New York.

Project Engineer. Work involved preparing bid estimates for various heavy construction railroad and highway projects.

1948 to 1950:

New York City Board of Water Supply.

Assistant Civil Engineer. Survey Party Chief and Concrete Inspector on construction of the Merriman Dam, Lackawack, New York.

ROBERT C. HUNDLEY
Department Head and
Pumped-Storage Specialist

Degrees: Bachelor of Science in Civil Engineering
(Hydroelectric Option)
University of Illinois, 1953

Harza Engineering Company 1953, 1954-56, since 1960.

Department Head and Pumped-Storage Specialist, Power Resources Division, 1975 to date, Assistant to Chief Hydroelectric Engineer, 1973-75; Civil Design Engineer, Power Project Divisions, 1971-72; Hydroelectric Engineer, Planning Division, 1960-70; Junior Engineer, Civil Division, 1954-56; Field Engineer, Box Canyon Project, 1953.

Experience Highlights:

Project Manager for major pumped-storage hydroelectric projects including the 1,000-MW Mount Hope Project, New Jersey, the 2,000- to 3,000-MW project in northern Illinois; the 500-MW Montezuma Project, Arizona, the 800- to 1,000-MW Wisconsin Survey; and two site surveys for Illinois. Participated in the development of multi-level, underground pumped storage. Made studies for five utilities including the Mount Hope Project and the Northwest Illinois Project.

Participated in studies for the following pumped-storage hydroelectric projects: the 2,000-MW Bluestone Project, West Virginia; the 2,100-MW Bath County Project, Virginia; the 500-MW Havasu Project, Arizona, Maryland sites, the 328-MW Brookville Project, Indiana; the 125- to 525-MW Raystown and 380-MW Seneca Projects, Pennsylvania, the 500- to 2,000-MW Merrimac Project, Wisconsin, Metropolitan Sanitary District of Chicago; and the Genesee River Basin Project, New York.

Studies of conventional hydroelectric power projects including 2067-MW Guri, Venezuela; 140-MW Pisayambo, Ecuador; 1200-MW Nez Perce-High Mountain Sheep; 788.5-MW Priest Rapids and 831.3-MW Wanapum, Washington, 135-MW Cerron Grande, El Salvador, and 120-MW Tavera-Bao-Lopez, Dominican Republic.

Participated in preparation of license applications to FPC for Mount Hope, Bath County, Montezuma, and Seneca Pumped-Storage Projects; existing Deep Creek, Raystown and Warrior Ridge Projects for the Pennsylvania Electric Company; the Priest Rapids Project, and preparation of Form 6, Original Cost Statement, for the Seneca Project.

Participated in river diversion studies for the Bath County Pumped-Storage Project, and for Guri, Tarbela Dam, Priest Rapids, Wanapum and Derbendi Khan Hydroelectric Projects.

1956 to 1960:

Corbetta Construction Company, Chicago, Illinois.

Construction Superintendent.

Expeditor, Cost Control, and Estimator.

Project Engineer. Field work included expediting subcontractors' and contractor's work.

ROBERT C. HUNDLEY

1953 to 1954:

Sewell and Sewell, Newport, Washington. (Leave of absence from Harza Engineering Company.)

Box Canyon Project. Responsible for inspection of powerstation construction.

1952 to 1953:

Illinois State Water Survey.

Instrument Man. Conducted silt survey of ponds and lakes in central Illinois while attending University of Illinois.

Technical Papers and Articles:

Lecturer: Short course on "Underground Construction and Underground Pumped-Storage Concept," at the University of Wisconsin, Milwaukee, 1975.

RICHARD S. IVEY
Vice President, Director of Planning

EDUCATION

M.A., Political Science, University of California at Berkeley, 1955.
B.A., Political Science, Reed College, 1950.

EXPERIENCE

Richard Ivey is Director of Planning at CH2M HILL. He is responsible for comprehensive city and regional planning and environmental planning.

Before joining CH2M HILL, Mr. Ivey served for seven years as research assistant professor and consultant with the Bureau of Governmental Research and Service, University of Oregon. In this position he served concurrently as a staff consultant to the League of Oregon Cities. His research and consulting experience included studies in local government organization and operations, municipal finance, personnel administration, law enforcement administration, municipal law, and city and regional planning. Mr. Ivey served as University consultant to cities and counties in Oregon in connection with the preparation of comprehensive city and regional plans and land use regulation. In 1965 Mr. Ivey served as consultant to the Tri-county Advisory Committee on the proposed Oregon Dunes National Seashore. His assignments also included the establishment of county-wide planning programs in Coos, Lincoln, and Tillamook Counties on the Oregon coast, and the development of comprehensive plans in more than twenty cities and counties throughout the state.

Mr. Ivey joined CH2M HILL in 1964. He served four years as principal consultant to the Southeastern Washington Regional Planning Commission and the Clearwater Valley (Idaho) Regional Planning Commission, a bi-state program for the development of a comprehensive regional plan for growth anticipated from Lower Granite Dam and slackwater navigation to the Port of Lewiston. Mr. Ivey later served as consulting planner for a number of cities and counties in the Pacific Northwest, California and Alaska.

In 1969 and 1970, Mr. Ivey was the principal consultant to the City of Portland for the Portland Downtown Plan, a major planning program that combined the resources of the City Planning Department, the Oregon State Highway Division, and CH2M HILL. More recent assignments have included the direction of a

major highway location project through Metropolitan Portland and the study of traffic impacts on inner-city neighborhoods associated with the design of a major freeway river crossing. He has prepared or directed environmental impact studies for a variety of projects in both urban and non-urban settings.

Since 1964, Mr. Ivey has served as planning advisor to the Warm Springs Indian Reservation in Oregon and has participated in planning and economic studies for other Indian reservations in the Pacific Northwest.

In Alaska Mr. Ivey has recently had responsibility for community impact studies in the Kenai Borough in connection with offshore oil development. He served as a consultant to the U.S. Corps of Engineers in connection with the community involvement element of the Corps' water quality study in Anchorage.

Mr. Ivey has lived and traveled in Europe and Asia and has served as a lecturer and visiting critic at several universities.

MEMBERSHIP IN ORGANIZATIONS

American Institute of Certified Planners
American Society of Planning Officials
Urban Land Institute

KHALID JAWED
Hydrologist

Degrees: Master of Science in Civil Engineering
Hydrology and Water Resources Branch
Colorado State University, 1973
Bachelor of Science in Civil Engineering
University of Punjab, Pakistan, 1958

Languages: English, Urdu, and reading knowledge of Farsi.

Harza Engineering Company, 1964-65; Since 1976.

Environmental Sciences and Hydrology Division: Hydrologist, 1976 to date;
Planning Division: Hydrologist, 1964-65.

Experience Highlights:

Performs hydrologic analyses including those for determination of spillway design floods, flood and drought frequency, derivation of unit hydrographs, reservoir operation, and ground-water movement and yields. Field activities include design and installation of meteorological and hydrologic stations, stream gauging, and sediment sampling and laboratory analysis.

Specific assignments included cross drainage studies for the Gotvand Irrigation Project, Iran; reservoir operations studies for the Kajakai reservoir, Afghanistan; water supply and probable maximum precipitation studies for the Jordan Valley Stage II Irrigation Project, Jordan; backwater analysis, and rainfall frequency analysis for the Upper Morass Project, Jamaica; and design of automated remote hydrologic and meteorological networks for the Guri Final Stage Project, Venezuela.

1973 to 1976:

Water and Power Development Authority (WAPDA), Lahore, Pakistan.

Senior Engineer. Responsibilities included compilation, interpretation and publication of hydrometeorological data collected by WAPDA, computations of suspended sediment load transported by rivers, associated with Harza Engineering Company International at Lahore, Pakistan for preparing report titled, "Appraisal of Flood Management Systems in Pakistan, Volume I – Flood Forecasting and Flood Warning Systems, Volume II – Existing Flood Control Structures and Recommendations for a Planning Program."

1971 to 1973:

Colorado State University, Fort Collins, Colorado.

Graduate Research Assistant. Research work included runoff-rainfall relations, unit hydrograph studies, multivariate analysis, and flood-frequency analysis. One month training in Hydrologic Engineering Center, Corps of Engineers, U. S. Army, Davis, California.

KHALID JAWED

1965 to 1971:

Water and Power Development Authority (WAPDA), Lahore, Pakistan.

Senior Engineer. Responsibilities included compilation, interpretation and publication of hydrometeorological data collected by WAPDA, computation of suspended and bed load transported by river and canals.

1964 to 1965:

Harza Engineering Company, Chicago, Illinois.

Training in applied hydrology. Work included rainfall-runoff relations, computation of backwater profiles, computations of maximum probable storm and flood; generation of streamflow records, and evapotranspiration computations.

1960 to 1964:

Water and Power Development Authority (WAPDA), Lahore, Pakistan.

Senior and Junior Engineer, respectively. Responsibilities as a Senior Engineer included collection of basic data for ground-water investigations, study of changes in ground-water levels, analysis of aquifer-test data for transmissibility and specific yield.

Duties as a Junior Engineer included installation, maintenance and operation of all instruments and related structures required for hydrometeorological investigation, collection of hydraulic parameters for existing canal systems in Pakistan, verification of Lacey regime canal formulae, collection and laboratory analysis of suspended sediment and bed material samples.

1958 to 1959:

Punjab Irrigation and Power Department, Pakistan.

Sub-divisional Officer. Duties included design of a small irrigation scheme, and discharge observations on rivers and canals.

Technical Papers and Articles:

Responsible for the following WAPDA publications

Annual Reports of River and Climatological Data of West Pakistan Rivers, 1963 through 1970.

Sediment Appraisal of West Pakistan Rivers, 1967, 1969, 1970 and January 1975.

Snow Surveys of West Pakistan, June 1969.

Basic Data Release – Ground Water Levels in Bahawalpur Area, 1964.

Instructions on Stream Gauging and Sediment Sampling, April 1967.

Instructions for River Gauge Observers, January 1967.

Co-Author for U. S. G. S. Water Supply Paper 1608-K, "Water Resources and Related Geology of D. I. Khan District, Pakistan," with reference to availability of ground water for development.

Procedures Followed for Finalizing Discharge, Sediment, Water Quality and Climatological Record, Surface Water Hydrology Project, WAPDA, July 1974.

Master of Science Thesis "Comparison of Methods of Deriving Unit Hydrographs."

Special Study for M.S.: "A Study of Relationship between Watershed Parameters and Peak Discharge."

Co-author for Colorado State University Publication No. 73KJ-RR-EF34, "Deriving a Unit Hydrograph in the Absence of Detailed Rainfall Data," June 1973.

JAMES JAY KELLER
Head, Transmission and Distribution Division

Degree: Bachelor of Science in General Engineering
University of Illinois, 1953

Languages: English, knowledge of Italian, Portuguese and Spanish

Professional Engineer – Illinois, Michigan and New York

Registered Land Surveyor – Illinois and Michigan

Professional Societies:

American Congress on Surveying and Mapping (former)
American Society of Civil Engineers
CIGRE – UHV/EHV Substations Working Group – 23-01 (former)
Institute of Electrical and Electronics Engineers
IEEE Towers, Poles & Conductors Subcommittee
Chicago Chapter, IEEE/PES (Chairman)
Illinois Society of Registered Land Surveyors
Michigan Society of Professional Engineers (former)
Michigan Society of Registered Land Surveyors

Harza Engineering Company 1965-68; 1973 to date.

Electrical Design Branch: Head, Transmission and Distribution Division, 1976 to date, Head, Transmission and Distribution Department, 1973-76; Project and Field Engineer, Pakistan, 1965-68.

Experience Highlights:

Responsible for all phases of transmission and distribution engineering.

Project Manager for TAVANIR EHV Transmission System, Iran. Project includes 800 kilometers of single circuit transmission line over half of which passes through elevated mountainous terrain. Project also includes four 400/230-kV, 400-MVA substations.

Project Manager for extension of 500-kV Transmission System, Guddu to Multan and Lyallpur, Pakistan, 330 miles of single circuit line passing through desert area and crossing two major rivers. Project includes one 220-kV substation.

Field Engineer responsible for specifications, bid evaluations, and contract administration for supply and erection of 135 miles of 220-kV transmission lines and additions to one major thermal generating station switchyard and one major switching station, West Pakistan. These additions included installation and commissioning of four 63.5-MVA, 220/132-kV power transformers, several 200 and 132-kV bays including additional bus, air blast circuit breakers and associated control, metering and protection equipment.

Project Engineer on a new generating station of four 15-MVA gas turbines and associated substation and for supervising other engineers in related construction management and office staff positions, West Pakistan. Served in advisory position to the General Manager, Chief Engineers and the Chairman of a medium-sized electric utility in Asia. In addition, trained and supervised foreign engineers and technical personnel.

1968 to 1973:

Commonwealth Associates, Inc., Jackson, Michigan.

Substation Project Manager for special projects including 345-kV substation design review for Taiwan Power Company, establishing criteria for substation bus design, and preparing proposals for substation, transmission, and distribution work. Also provided technical back-up to Rio de Janeiro Office of Inter-America Consultants, Inc.

Resident Director of technical operations, Inter-America Consultants, Inc., Rio de Janeiro, Brazil (subsidiary of Commonwealth Associates), responsible for engineering supervision and design of nearly 2,000 miles of 500, 345, and 230-kV transmission lines, two 345-kV, one 230-kV and three 500-kV substations.

Project Manager on 500 and 230-kV substations, Gulf States Utilities (Texas) and worked on Delmarva Power & Light 500-kV/230 1300 MVA substation and preliminary studies for 345-kV switchyard at the Ohio Edison Bruce Mansfield Plant, Pennsylvania. Also, participated in studies and preliminary design work on the economic and technical feasibility of 765-kV transmission systems.

1962 to 1965:

Miner and Miner International, Lahore, West Pakistan.

Electrical Engineer on design of 800 miles of 132 and 66-kV transmission line, and 500 miles of 11-kV distribution lines.

1960 to 1962:

Commonwealth Associates, Inc., Jackson, Michigan.

Transmission Project Engineer on 138 and 345-kV transmission lines in Illinois, Ohio and New York.

1955 to 1960:

George E. Snyder Associates, Jackson, Michigan.

Structural Engineer and Head, Surveying Department Responsibilities included design development and testing of aluminum alloy, modular distribution substation structures for 13, 34.5 and 69-kV as well as small highway bridges, and all surveying operations of the firm.

1953 to 1955:

Commonwealth Associates, Inc., Jackson, Michigan.

Associate Design Engineer on development of modular steel 69-kV substations and foundations, meeting National Electric Manufacturers Association requirements. Worked in the Architectural Division on utility service buildings, and assisted in supervising a gas distribution mapping program.

1946 to 1953:

State of Illinois – Division of Waterways.

Rodman to party chief while attending University of Illinois.

1944 to 1946:

U S. Army Signal Corps, Adak, Alaska.

Maintenance of A.F.R.S. Radio Station WXLB operated on 900 KC.

Technical Papers and Articles:

"An Investigation of Failures of 66 and 132-kV Transmission Lines West Pakistan," 1964.

"Designing Transmission Lines for Corrosive Atmospheres," 1966.

"Ruido Acustico Y Radio Interferencia Emitidos Por Lineas De Transmission Y Subestaciones De 500-kV," co-author with L. H. Luzuriaga and presented at Buenos Aires, Argentina during XXIII Semana De La Ingenieria Electrica Y Electronica – 13 al 17 Setiembre, 1971. (IEEE Argentina Section).

DONALD J. KLEVEN

Education

B.S., Civil Engineering, Montana State University, 1971

Experience

Mr. Kleven joined CH2M HILL in 1979, prior to which he was employed by Santa Fe Engineering Services, Inc., as flowline superintendent responsible for direct supervision of a quality control/contract management group on a project consisting of 115 miles of aboveground preinsulated crude oil pipeline with associated pipe supports in Sohio's operating oil field at Prudhoe Bay, Alaska. The flowline quality control/contract management group consisted of 35 to 40 personnel, including discipline supervisors, field engineers, engineering technicians, and inspectors.

Prior to employment with Santa Fe Engineering Services, Inc., Mr. Kleven was employed by Brown and Root, Inc., as pipeline supervisor. Brown and Root, Inc., was the general contractor responsible for the engineering and construction of the gathering system for the west half of the Prudhoe Bay oil field. Responsibilities included contract management, quality control, material flow, and field engineering related to construction of all pipelines and appurtenances in the above gathering system, including approximately 120 miles of 6-inch line and 20 miles of large-diameter piping.

Also, while employed by Brown and Root, Inc., Mr. Kleven was assigned as assistant superintendent of hydrostatic testing for Arctic Constructors on the Alaska Pipeline System, Sections 5 and 6.

As a design engineer with Pipeline Technologist Inc. in Houston, Texas, Mr. Kleven was assigned as a staff engineer on the following projects:

- El Paso Alaskan Gasline Study
- Five-million-barrell crude oil storage tank farm for Amerada Hess at Collins, Mississippi
- Two-million-barrel crude oil storage tank farm for Amerada Hess at Ten Mile, Alabama
- Converting an existing 12-inch products line to a crude oil line from Port Arthur, Texas, to Longview, Texas, including original pump station, intermediate pumping facilities, and termination storage facilities

DONALD J. KLEVEN

Mr. Kleven has also worked for a water and sewer utilities contractor as a field engineer.

Professional Registration

Alaska

Membership in Organizations

American Society of Civil Engineers
Chi Epsilon
Tau Beta Pi

RICHARD F. KOKEN
Associate and
Chief Construction Engineer

Degree: Bachelor of Arts in English and Mathematics
University of Oregon, 1936

Languages: English, speaking knowledge of Hindustani, and working knowledge of German

Professional Engineer – Chartered Mechanical Engineer, India Commission No. 3587 from National Board of Boiler and Pressure Vessel Inspectors – American Society of Mechanical Engineers.

Professional Societies:

Institute of Engineers, India

Harza Engineering Company since 1969.

Associate, 1978.

Chief Construction Engineer, 1978 to date; Construction Management Division: Head, 1974-78; Senior Construction Engineer, 1973-74; Resident Manager, Indonesia, 1972-73; Construction Plant Engineer and Acting Resident Manager, Indonesia, 1969-72.

Experience Highlights:

Head, Construction Management Division. Division activities include preparation of contract documents, cost estimates, construction planning and scheduling, construction inspection, contract administration, and technical procurement.

Construction Plant Engineer, acting Resident Manager, and Resident Manager respectively, of the Irrigation Rehabilitation Project, Indonesia. Prepared master plans and assisted the Government of Indonesia in all matters related to construction equipment and management operations for the irrigation of about 400,000 hectares (1 million acres) of land.

1966 to 1969:

The Ralph M. Parsons Company, Los Angeles, California.

Project Manager on engineering projects in East Pakistan, Zambia, India, Argentina, Nicaragua, and Tunisia. Responsible for fulfilling contractural obligations, maintaining budgetary control and schedules, and coordinating business developments.

RICHARD F. KOKEN

1958 to 1966:

The Ralph M. Parsons Company, India.

Project Manager and Construction Plant and Equipment Advisor to Government of India. Responsible for establishment and operation of heavy equipment training centers throughout India as well as supervision of mechanic and operation specialists in training personnel for operation and maintenance of large earthmoving and transportation equipment used in construction.

Construction Plant and Equipment Advisor involved in planning and layout for construction of multi-purpose irrigation and power projects.

1955 to 1958:

Morrison Knudsen International Company, South Korea.

Mechanical Superintendent. Responsible for rehabilitation of Hwachon Dam, involving repair of two Hitachi 30,000 kVA generators, installation of one 30,000 kVA generator with Francis turbine, and a three-phase 30,000 kW transformer.

1953 to 1955:

Government of Punjab, India.

Mechanical Supervisor for the Bhakra Nangal Project. Supervised rebuilding and installation of the largest refrigeration plant for aggregate cooling in Asia.

Member of the Construction Plant and Machinery Committee, Ministry of Irrigation and Power, Government of India.

1948 to 1953:

U.S. Bureau of Reclamation, Grand Coulee Dam, Washington.

Equipment Supervisor. Responsible for maintenance, aquisition, assignment, and disposal of all mobile, laboratory, engineering, repair shop, and special equipment utilized by 480 employees in the operation and maintenance of the dam, waterways, powerhouses, pumping plants, switchyards, feeder canals, and the equalizing reservoir.

Technical Publications:

"Lessons in Operation and Maintenance, Earthmoving Equipment." Instruction textbook published in New Delhi, India, funded by USAID. Richard F. Koken, author.

"Tips on Operation, Earthmoving Equipment." Instruction manual for operation of large machinery, published in New Delhi, India, funded by USAID. Richard F. Koken, author.

JOHN J. KURUC
Plant Ecologist

Degrees: Master of Science in Botany
University of North Carolina, Chapel Hill, 1973
Bachelor of Science in Biology
Moravian College, Bethlehem, Pennsylvania, 1966

Languages: English and reading knowledge of French and Spanish

Professional Societies:

American Association for the Advancement of Science
Ecological Society of America

Harza Engineering Company since 1976.

Environmental Sciences Division: Plant Ecologist, 1976 to date.

Experience Highlights:

Responsibilities include evaluation of natural resources with particular emphasis on plant communities, determination of botanical effects of projects, recommendations for mitigating actions, and preparation of botanical sections of environmental reports.

Environmental Task Leader for a feasibility study evaluating alternative construction and operation designs for increasing the generating capacity of five interconnected low-head hydropower stations on the St. Joseph River, Michigan and Indiana. Prepared a reconnaissance report on the environmental effects anticipated from the modernization and expansion of a low-head hydropower station on the Susquehanna River, Pennsylvania.

Environmental Task Leader for the preparation of Exhibits R, S, V, and W of a FERC License Application for a hydropower development on the Kootenai River, Montana. Additional duties included Acting Project Manager for coordinating the entire license application to state and federal regulatory agencies, coordinating responses to agency review comments, and participating in public presentations.

Developed a land reclamation plan for restoring an abandoned underground mine site and mine waste disposal area in south-central Illinois into a regional wildlife and recreation natural resource. Developed a conceptual reclamation plan for revegetating and providing alternative land uses for lands degraded by temporary flood water storage behind the proposed Burlington Dam on the Upper Souris River, North Dakota. Also evaluated the potential for increased mosquito production in stored flood waters and recommended appropriate mosquito control and monitoring techniques.

Environmental Task Leader for a feasibility study of developing conventional hydropower generating capabilities at three existing flood-control dams on the Gauley, Elk, and Bluestone Rivers in West Virginia. The Bluestone River study also included an environmental assessment and comparison of alternative upper pumped-storage reservoir sites.

JOHN J. KURUC

Active on several overseas projects, including environmental management programs for the Yacyreta Reservoir development on the Rio Parana, Argentina and Paraguay. Programs involved reestablishing and managing reservoir margin forest stands for preserving selected riparian tree species and providing wildlife habitat and alternatives to present land use options. Assisted in an economic analysis of alternative cropping patterns for an agricultural development in the Upper Morass of the Black River, Jamaica.

Prepared an environmental assessment for a feasibility study of the irrigation development of 80,000 acres in southwestern South Dakota. Assessment also included recommendations for enhancing wildlife habitat.

Prepared an environmental siting study for a proposed nuclear power station cooling reservoir on a tributary of the Wabash River, Indiana. Assessed and compared environmental impacts of alternative above-ground pipeline corridors for cooling water supplier in north-central Illinois.

Participated in the preparation of the Draft Environmental Impact Statement for the rehabilitation of Lock and Dam No. 1 on the Mississippi River, Minnesota.

Environmental Task Leader for an environmental siting study of a perched and underground pumped-storage reservoir complex in north-central Illinois.

Evaluated the potential and prepared a developmental scheme for developing flood-compatible outdoor recreation facilities along a 17-mile urbanized section of the Rock River floodway, Illinois.

1973 to 1976:

Environment Consultants, Inc., Dallas, Texas.

Field ecologist in residence for a one-year detailed field survey of the flora and fauna of the islands of American Samoa, Rose Atoll, and Swains Island. Designed, coordinated, and conducted field studies analyzing the island's plant communities, soil types, forest microclimates, wildlife habitats, and land-use patterns.

Participated in the preparation of numerous environmental assessment reports, including Environmental Impact Statements for fossil fuel and nuclear power electrical generating plants and multipurpose reservoir developments in Texas, North and South Carolina, Indiana, Ohio, and Kentucky.

Reviewed and evaluated land reclamation programs for restoring lignite surface strip mines, and assessed impacts of mine-mouth power plant developments in eastern and southeastern Texas.

Recommended wildlife habitat enhancement and management programs for proposed resort developments in New York, Texas, and Mexico.

1971 to 1973:

University of North Carolina, Chapel Hill, North Carolina.

Teaching and Research Assistant. Taught lab courses in general and economic botany, ecology, and plant taxonomy. Conducted ecological field studies on barrier island plant communities and physiological ecology of individual species.

1968 to 1970:

U. S. Army.

HARZA ENGINEERING COMPANY

WILLIAM R. LARSEN
Resident Manager and Geohydrologist
Zanja del Tigre Project, Argentina

Degrees: Master of Science in Hydrology
University of Nevada, 1967
Bachelor of Science in Geology
University of Wisconsin, Milwaukee, 1964

Languages: English, Spanish and working knowledge of German

Professional Geologist – California

Professional Societies:

Association of Engineering Geologists
International Water Resources Association
National Water Well Association

Harza Engineering Company since 1967.

Resident Manager and Geohydrologist, Argentina, 1972 to date; Resident Manager and Geohydrologist, Guatemala, 1971-72; Water Resources Division; Geohydrologist, 1967-71.

Experience Highlights:

Resident Manager and Geohydrologist for the Zanja del Tigre Project, Argentina. Supervised, administered, and coordinated field and office investigations by Harza and local joint-venture team during the feasibility studies for the $200 million storage dam and powerplant (450-MW) and the prefeasibility level studies of downstream irrigation and settlement potential. Also supervised the $500,000 exploratory geologic investigation of the dam site and reservoir area, which included core drilling, aquifer permeability testing, geophysical surveying, and topographic mapping.

Resident Manager and Geohydrologist for the Northern Guatemala Study. Supervised and administered groundwater, geologic, hydrologic, and agricultural field investigations for the prefeasibility studies of five potential irrigation and hydroelectric projects in northern Guatemala.

Other groundwater and surface water resources assignments have included analysis and description of exploratory investigations in selected areas of the Marun and Karun River Basins, Iran; estimates of approximate groundwater yield for municipal, industrial and irrigation water supply in the St. Lawrence River Basin, New York State; analysis of results of groundwater observation program to determine possible effects of drainage canals in rice growing areas of lower Guinea; and analysis and evaluation of historic hydrometeorological records for design storm and flood studies for Guri Dam, Venezuela.

WILLIAM R. LARSEN

Prepared and conducted model studies to determine design criteria for placement of granular fill in deep water, evaluated storm and rainfall frequency data to determine volume of storage required to accommodate runoff from maximum storm events, and supervised lacustrine-exploratory drilling and seismic surveys for the Lake Michigan Airport studies.

1964 to 1967:

University of Nevada.

Graduate Student, under National Science Foundation Fellowship Traineeship.

Desert Research Institute, University of Nevada. Graduate Research Assistant, Hydrology Section, one year.

1964:

Illinois State Geological Survey; Urbana, Illinois.

Research Assistant, Groundwater Geology and Geophysical Exploration Section.

1960 to 1964:

University of Wisconsin in Racine, and University of Wisconsin, Milwaukee.

Undergraduate Student.

1957 to 1960:

U.S. Army

Classified Communication Work.

Technical Papers and Articles:

"Hydrologic and Geologic Aspects of Ground Water Recharge Along the Humboldt River Near Winnemucca," HUMBOLDT RIVER STUDIES, PROJECT REPORT NO. 10, Center for Water Resources Research, Desert Research Institute, University of Nevada System, Reno, July 1968.

"Ground Water Studies Chicagoland Deep Tunnel System," (with I. S. Papadapoulos), GROUND WATER, Jour., National Water Well Association, September, 1969.

BAUM K. LEE
Head, Surface-Water Hydrology Department

Degrees: Ph.D. in Civil Engineering — Hydraulics
Colorado State University, 1973
Master of Science in Civil Engineering — Hydraulics
Colorado State University, 1969
Bachelor of Science in Civil Engineering
Seoul National University, Seoul, Korea, 1963

Languages: English, Korean, and working knowledge of Chinese, German, Japanese, and Spanish

Professional Societies:

American Geophysical Union
American Society of Civil Engineers
Korean Association of Hydrologic Sciences
Korean Society of Civil Engineers

Harza Engineering Company since 1973.

Hydrology Division: Senior Hydrologist and Head, Surface-Water Hydrology Department, 1978 to date.
Water Resources and Environmental Sciences Division: Water Resources Engineer, 1973-78.

Experience Highlights:

Supervises, coordinates, and performs flood and storm analyses, sedimentation and erosion studies, stochastic hydrology, mathematical modeling, and determination of water availability for domestic and overseas projects.

Resident Hydrologist, Ecuador and Peru, for the Puyango-Tumbes Multipurpose Project to provide irrigation water, hydroelectric power, flood control, and fisheries development. Prepared hydrology report, supervised counterpart staffs for hydrologic studies, and trained local hydrologists.

Established a sedimentation laboratory and a streamflow and sediment measurement program, and trained local hydrologists, for the El Nispero Hydroelectric Project, Honduras.

Served as Project Manager for the Receiving Water Study, Garrison Diversion Unit, North Dakota. Studied effects of irrigation return flows on 22 water-quality parameters in 1,400 miles of streams by using mathematical models.

1967 to 1973:

Colorado State University.

Graduate Research Assistant working for the U.S. Geological Survey.

Major research projects participated in were: dependent and independent variables in sediment transport; resistance to flow in alluvial channels; dispersion characteristics of sand particles in an alluvial stream; stochasticity in transport and dispersion of sediment particles; and Hurst phenomena of dye dispersion in

natural rivers. These projects included general laboratory and field work in connection with the collection, reduction, and analysis of sediment transport data using a large recirculating flume and a high-speed digital computer.

1966 to 1967:

Korean Engineering Consultant Corporation, Seoul, Korea.

Group Leader, Hydrology Group, Water Resources Division.

Specific duties included the supervision of five junior civil engineers. The major responsibility of the group was hydrologic and hydraulic analysis for the design report of a multipurpose dam to be built by the Korean Government.

1964 to 1966:

Active military duty in the Eighth U.S. Army Support Command as a Korean Augmentation to the United States Army.

1963 to 1964:

Korean Engineering Consultant Corporation, Seoul, Korea.

Junior Civil Engineer, Hydrology Group, Water Resources Division.

Responsibilities included unit hydrograph and flood analysis, statistical estimation of turbine discharge, and installation and subsequent analysis of rain and stream gauges for feasibility studies of hydroelectric power projects.

Technical Papers and Articles:

"Laboratory Study of an Alluvial Stream at One-Foot Depth," M.S. Thesis, Civil Engineering Department, Colorado State University, Fort Collins, 52 pp., 1969.

"A Review of Some Stochastic Models for Sediment Transport," (unpublished), Civil Engineering Department, Colorado State University, Fort Collins, 80 pp., 1972.

"Stochastic Characteristics of Particle Movement Over a Dune Bed," with H. E. Jobson, International Symposium on River Mechanics, Bangkok, Thailand, Proceedings Vol. 1, 15 pp., 1973.

"Stochastic Analysis of Particle Movement Over a Dune Bed," Ph.D. Dissertation, Colorado State University, Fort Collins, 216 pp., 1973.

"Stochastic Analysis of Dune Bed Profiles," with H. E. Jobson, Journal of Hydraulics Division, ASCE 100 (HYT) pp. 849-867, 1974.

"Stochastic Analysis of Particle Movement Over a Dune Bed," with H. E. Jobson, U.S. Geological Survey Open File Report, Bay St. Louis, Mississippi, 221 pp., 1975.

"Stochastic Analysis of Dune Bed Profiles (Closure)," with H. E. Jobson, Journal of Hydraulics Division, ASCE 101 (HY. 11), pp. 1445-1447, 1975.

"Stochastic Analysis of Particle Movement Over a Dune Bed," with H. E. Jobson, U.S. Geological Survey Professional Paper 1040, Washington, D.C., 72 pp., 1977.

HARZA ENGINEERING COMPANY

KENNETH R. LEONARDSON
Department Head,
Power Projects Division

Degrees: Bachelor of Science in Civil Engineering
University of Illinois – Hydraulics
Option, 1954

Professional Engineer — Illinois and Washington

Professional Societies:

American Society of Civil Engineers

Harza Engineering Company 1970 to date; 1957-1969; 1954-1955.

Power Projects Division: Division Head, 1978 to date; Department Head, 1972-78; Section Head, 1970-72 and 1967-69; Group Leader, 1965-67; Civil Engineer, 1957-64; Junior Engineer, 1954-55.

Experience Highlights:

Project Manager for 140-MW hydroelectric plant on the Kootenai River in Montana, during the FERC License Application.

Project Manager for 210-MW Hrauneyjafoss hydroelectric project in Iceland for preparation of contract documents.

Prepared feasibility report on the expansion of the Cowlitz River Salmon Hatchery in Washington State.

Conducted studies for new intakes for the Dresden and Quad Cities nuclear power plants.

Engineer responsible for design and construction drawing preparation for third unit at Smith Mountain pumped-storage hydroelectric plant, Virginia.

Project Manager for reconstructing an existing hydro plant to a "tube turbine" hydro-generating plant, Cornell, Wisconsin, through feasibility study, design and engineering services during construction; and repairs to Upper Occoquan Dam, Virginia, through preparation of contract and construction drawings.

Supervised the preparation of construction drawings for the spillway of the 200-meter high concrete arch Reza Shah Kabir Dam, Iran; the morning glory spillway and outlet works for the Electric Lake Dam, Utah; and the gravity water supply pipeline and trashrack for the River Mill Fishway Modifications, Oregon.

Prepared report on making waterfalls passable to fish for the Brule and Stewart Rivers, Minnesota.

Participated in the hydraulic and structural design for the Wanapum Dam fish passage facilities and supervised the preparation of construction drawings for the right bank fish ladder at Wanapum Dam, Columbia River, Washington.

KENNETH R. LEONARDSON

1969 to 1970:

State of Washington, Department of Fisheries.

Duties included fish hatchery design and inspection of fish facilities throughout the state.

1964:

State of Washington, Department of Fisheries.

Hydraulic Engineer, Research Division.

1955 to 1957:

United States Army; Engineer Corps.

Topographic Surveyor in 320th Engineer Company.

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
- ACI Committee 211 — Proportioning Concrete Mixes
- ACI Committee 221 — Aggregates
- ACI Committee 309 — Consolidation of Concrete

Harza Engineering Company since 1973.

Foundations and Soil Mechanics Division. 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.

GARY R. MASS

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 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.

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:

Department of Highways, State of Alaska, Juneau, Alaska.

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.

RICHARD L. MEAGHER
Senior Associate and Acting Head,
Resources Development Branch

Degree: Bachelor of Science in Civil Engineering
University of Notre Dame, 1956

Professional Engineer – Illinois

Professional Societies:

American Society of Civil Engineers

Harza Engineering Company since 1956.

Senior Associate, 1978.

Associate, 1974.

Resources Development Branch: Acting Head, 1978 to date, Assistant Head, 1977-78, Head, Power Resources Division, 1972-76; Planning and Civil Design Supervisor, 1962-72; Structural Design Engineer, 1958-62, Planning Engineer, 1956-58.

Experience Highlights:

Directs, supervises, and reviews the work of engineers, resource specialists, and drafters in planning the development of land, water, and energy resources. Studies include master plans as well as appraisal, prefeasibility, and feasibility of projects. Evaluations are based on engineering, environmental, economic, and financial considerations.

Project Manager for feasibility studies and FERC license application for the Brumley Gap and Powell Mountain Pumped-Storage Projects in Virginia, each with an installed capacity of more than 3,000 MW.

Project Director for the following studies in Honduras: feasibility of El Nispero Hydroelectric Project, feasibility of Quimistan Valley Irrigation Project; and Flood Control Master Plan for Sula Valley.

Project Director for appraisal of underground pumped-storage potential in Illinois.

Project Director for inventory of hydroelectric resources in eastern Honduras in which seven sites with a total installed capacity of 1,700 MW were identified.

Project Director for the prefeasibility study of a 450-MW hydroelectric development on the Rio Chimbo in Ecuador.

Project Manager for the study of the Patia River Basin in Southwest Colombia. The study involved identification of all sites having potential for construction, preliminary evaluation to determine the most favorable sites, and selection of two sites for feasibility study. The potential total development would be about 3,000 MW. Feasibility study for the initial project with installed capacity of 1,500 MW has been completed.

Project Manager for the prefeasibility study of the 3,000-MW Corpus Project on the Parana River, Argentina and Paraguay.

RICHARD L. MEAGHER

Project Manager for two hydroelectric planning studies in Bolivia. The first study recommended a plan of development for a reach of the Rio Grande in Bolivia about 350 km long with a fall of about 1,000 meters. The study identified nine potential hydroelectric project sites with a total installed capacity of 3,000 MW. The second study was for a prefeasibility report to evaluate two small hydroelectric projects in southern Bolivia which could serve a community with a population of about 30,000.

Project Manager for the feasibility study of the Hrauneyjafoss Project in Iceland which can serve expected growth in industrial load. The project will have an installed capacity of 210 MW.

Project Manager during planning phase of the Rio Caroni hydroelectric development in Venezuela involving four sites with a potential of about 15,000 MW. Supervised planning studies aimed at (1) appraising the overall development and (2) determining the technical and economic feasibility of a program for staged expansion at two sites which have been partially developed.

Project Manager for the feasibility phase of a major multipurpose river project in Iran, which includes the development of 40,000 hectares of agricultural land with an irrigation and drainage system, and the construction of a 200-m arch dam and a 1,000-MW power plant.

Senior Planning Engineer involved in preparation and supervision of planning studies for hydroelectric projects. Studies included project layouts and estimates, power production, and economic analyses. Also supervised design work and preparation of construction drawings for powerhouse, spillway, and diversion structures for hydroelectric projects.

ROLAND J. MESA
Senior Transmission and Distribution Engineer

Degrees: Bachelor of Science - Instituto Santiago, 1948 (Santiago de Cuba, Cuba)
Surveying and Land Assessment - Institute Santiago, 1948 (Santiago de Cuba, Cuba)
M.S. in Electrical Engineering - Havana University, 1953 (Havana, Cuba)
Distribution Systems Training Course - C.C.E. Havana, Cuba) 1959
Fortran Programming (S. & L. Chicago, Illinois), 1959

Languages: English and Spanish

Professional Engineer — Cuba, Illinois and Pennsylvania

Professional Societies:

Institute of Electrical and Electronics Engineers

Harza Engineering Company since 1973.

Transmission and Distribution: Senior Transmission and Distribution Engineer, 1973 to date.

Experience Highlights:

Senior Transmission and Distribution Engineer responsible for design engineering, economic evaluation of alternatives, and consulting on national and international HV and EHV transmission projects of up to 765 kV. Consulting design and engineering studies of distribution systems.

1964 to 1973:

Sargent & Lundy Engineers, Chicago, Illinois.

Project Engineer: Responsible for complete design of HV and EHV transmission lines, including: route selection, wood H-frame and single pole structural design, computer application for line design. Application of steel tower, steel pole and laminated wood structures.

Design Engineer: Design of transmission and industrial substations, including: line relays, switchgears, control and instrumentation, specifications, material selection and economic evaluations.

Electrical Analyst Engineer: Relays and breakers, selection and coordination for generating station units and substations: switchgear selection, voltage drops, short circuit calculation.

1961 to 1964:

United Engineers & Constructors Inc. Philadelphia, Pennsylvania.

ROLAND J. MESA

Senior Designer of steam generating units. Responsibilities included checked and correlated physical and schematic diagrams, including: control panels, switchgear data processing equipment. Development of basic schematic diagrams and of single line diagrams.

1956 to 1961:

Compania Cubana de Electricidad, Havana, Cuba.

Engineering Department: Design of all phases of rural and urban Transmission and Distribution Lines. Sag and tension calculation, tower spotting, selection of voltages, conductors, different types of structure, and hardware. Complete structure design for wood H-frame and single pole. Planning for electrical power distribution systems, including: voltage drops and loss calculations, use of capacitors and regulators, coordination programs. Studies and forecast of load growth. Economic studies and evaluation of different plans for improvement of distribution systems. Estimating and preparing budgets. Design of distribution substations.

Electrical Department: Division Engineer: Operation, maintenance, and improvement of transmission and distribution systems. Responsible for job coordination of maintenance personnel. Dealing with labor union in problems related with workers. Supervision of transmission lines construction. Construction supervision of 110/33kV substations.

Right of Way: Head of the Right of Way and Surveying Department.

1950 to 1956:

Alvira Engineering Company, Consulting and Constructors Engineers, Havana, Cuba.

Design, construction, and surveying of rural and urban transmission and distribution lines.

EDGAR T. MOORE, JR.
Associate and Head,
Civil Design Branch III

Degrees: Master's Degree in Business Administration
University of Chicago, 1969
Master of Science in Mechanics & Hydraulics
State University of Iowa, 1958
Bachelor of Science in Civil Engineering
University of Illinois—graduated with
high honors, 1957

Languages: English, Spanish and
working knowledge of Italian

Professional Engineer — District of Columbia, Illinois and Kentucky

Structural Engineer — District of Columbia and Illinois

Land Surveyor — Illinois

Professional Societies:

American Concrete Institute
American Society of Civil Engineers
Illinois Society of Professional Engineers; Chapter Officer 1962, 1963, and 1964
National Society of Professional Engineers
Association of Engineering Geologists

Harza Engineering Company since 1959.

Associate, 1971.

Head of Civil Design Branch III, 1978 to Date; Resident Chief Engineer of Harza de Venezuela, Caracas, 1976-77. Head, Power Projects Division II, 1973-76; Resident Chief Engineer, Yacyreta-Apipe Project, Argentina, 1972-73; Head, Transportation Division, 1971-72; Civil Design Branch, Department Head, 1967-71; Section Head, 1964-67; Group Leader, 1963-64; Designer, 1959-63.

Experience Highlights:

Project Director and Project Manager of various low-head and high-head hydroelectric and multi-purpose projects in South America, Caribbean, and Africa, for the preparation of feasibility reports, contract documents and construction drawings, with considerable personal experience in making overall project layouts including the layout, dimensioning and design of the projects' features, including concrete gravity dams, power intakes, power conduits and penstocks, powerhouses, spillways, outlet works, diversion works and river closures, and navigation locks.

Technical Papers and Articles:

Author of technical articles appearing in ASCE Civil Engineering magazine and ASCE Power Journal.

L. DOW NICHOL
Planning Engineer

Degrees: Bachelor of Science in Civil Engineering
University of Illinois, 1953
Bachelor of Law
The George Washington University, 1959

Languages: English and working knowledge of Spanish

Professional Engineer — Illinois

Professional Societies:

American Society of Civil Engineers

Harza Engineering Company since 1960.

Resources Development Branch: Power Resources Division:Department Head, 1975 to date; Resident Engineer, Colombia, S.A., 1973-75; Department Head, 1969-73; Planning Engineer, 1965-69; Civil and Structural Engineer, 1963-65; Planning Division: Civil Engineer, 1960-63.

Experience Highlights:

Conducted an appraisal of pumped-storage potential of the proposed Qattara Hydroelectric Development, Egypt.

Resident Engineer for the 1700-MW Sogamoso Project, Colombia, S.A. thru the feasibility study.

Directed the optimization studies to select the generating capacity and energy storage capacity of the 2100-MW Bath County Pumped-Storage Project, Virginia.

Directed a program of map studies and field reconnaissance to identify potential pumped-storage project sites in Maryland and West Virginia and compare them on the basis of economics and environmental factors.

Carried out portions of the layout studies for the underground power station for the 1710-MW Stony Creek Pumped-Storage Project, Pennsylvania.

Directed studies of possible addition of from 500 to 4500-MW of pumped-storage generating capacity to the basic storm overflow containment alternatives for the Chicago Tunnel and Reservoir Plan, Illinois.

Directed field reconnaissance of an undeveloped reach of 380 kilometers of river and preparation of prefeasibility report of hydroelectric development, including preparation of screening program for evaluation of the various sites, levels of development, and power markets for the Rio Grande Project, Bolivia.

Prepared recommendations of legislative revisions as part of report on state policy regarding disposition of obsolescent dams in Minnesota.

L. DOW NICHOL

Performed field reconnaissance and directed the preparation of appraisal report for two pumped-storage sites in the Philippines, including preparation of computer program for study of reservoir use by existing project jointly with pumped-storage project.

Directed the preparation of a report on remedial measures to preserve usefulness and appearance of a small scenic and recreational pond used also for storm drainage retention; directed preparation of contract documents for the Lake Ellyn renovation work, Illinois.

Assisted in preparation of report on valuation of an obsolescent hydroelectric project in connection with a transfer of ownership, Lake Byllesby Dam, Minnesota.

Prepared computer program for generator reliability analysis of a small, hydrothermal system, using probability method for the CEL System Expansion, El Salvador.

Participated in the economic studies and report regarding installation of a supervisory control system for Central Nebraska Public Power and Irrigation District.

Participated in conceptual planning; appraisal studies of several power projects; and review of reports for the Southern Bolivia Power Studies.

Drafted revised engineering services contract and negotiated with client in Addis Ababa for the 100-MW Finchaa Project, Ethiopia.

Participated in the preparation of testimony and exhibits presented in the Federal Power Commission license proceeding; analysis of testimony and exhibits of other parties for the Nez Perce and High Mountain Sheep Projects, Oregon and Idaho.

Layouts and estimates for use in planning studies for the Guri Project, Venezuela.

1959:

Merritt-Chapman and Scott Corporation, New York City, New York.

Office Engineer, Construction Division.

1956 to 1959:

John G. Loehler and Associates, Consulting Civil and Structural Engineers, Washington, D.C. and Kensington, Maryland.

1953 to 1956:

Ensign and Lieutenant, J.G., Civil Engineer Corps, U.S. Navy, Naval Gun Factory, Washington, D.C. and Naval Ammunition Depot, Crane, Indiana.

JAMES T. NIKOLAS
Vice President and
Head, Electrical Design Branch

Degrees: Master of Science in Electrical Engineering
Illinois Institute of Technology, 1958
Bachelor of Science in Electrical and Mechanical Engineering
Technical University of Athens, "Ethnikon Metsovion Polytechnion," Greece, 1953

Languages: English and Greek

Professional Engineer – Illinois, Indiana, South Carolina, and Greece.

Professional Societies:

Eta Kappa Nu Association
Institute of Electrical and Electronics Engineers
Sigma Xi Association

Harza Engineering Company since 1959.

Vice President, 1978.

Senior Associate, 1976.

Associate, 1970.

Head, Electrical Design Branch, 1975 to date; Chief Electrical Design Engineer, 1970 to 1975; Assistant Chief Electrical Design Engineer, 1967-70; Electrical Division: Department Head, Power Generation, 1966-67; Section Head, 1962-66; Group Leader, 1959-62.

Experience Highlights:

Start-up and field tests on 300-MW Mossyrock Project, Washington, USA and 80-MW Karadj Project, Iran.

Supervised and participated in preparation of design criteria and specifications and construction drawings for electrical equipment on the following hydroelectric projects: 2700-MW Yacyreta-Apipe, Argentina and Paraguay; 180-MW San Lorenzo, El Salvador; 210-MW Hrauneyjafoss, Iceland; 135-MW Cerron Grande, El Salvador; 300-MW Mossyrock, Washington; 1000-MW Reza Shah Kabir, Iran; 100-MW Finchaa, Ethiopia; 80-MW Rio Lindo, Honduras; 6-MW La Yeguada, Panama; 80-MW Karadj Project, Iran; 212-MW Angat Project, Philippines; and for the five diesel plants, CEMAT Project, Brazil.

Supervised preparation of electrical designs, plans and specifications for Cowlitz River Salmon Hatchery, Washington, and Conowingo Dam fish collection facilities, Maryland.

Project Director for electrical review for Prairie Island Nuclear Power Project, Minnesota; Assistant Project Director on turbine, governor, and generator testing on Malpaso Project, Mexico.

Project Director for Duncan High-Voltage Substation, Jamaica.

JAMES T. NIKOLAS

Assistant Project Director for the CEL System Expansion Oriente Region and the Soyapango Gas Turbine Plant, El Salvador.

Project Manager for temporary repairs and Project Director for studies for permanent restoration, contract documents, construction drawings, and engineering services during construction for the restoration of the Santee Cooper powerhouse, South Carolina, which was damaged by fire.

1956 to 1959:

Vern E. Alden Company, Chicago, Illinois.

Group Leader, fossil fuel generating station design.

1954 to 1956:

Public Power Corporation; Athens, Greece.

H. V. Substation Maintenance Engineer.

1953 to 1954:

Hellenic Electric Company; Athens, Greece.

Electrical Engineer.

Technical Papers and Articles:

IEEE paper C75-157-3, "Design Features of the Iranian 400 kV Transmission System." Co-Author.

1977 American Power Conference paper "Gas Insulated Switchgear Solves Difficult Problems at Hydroelectric Plants," Co-Author.

1977 American Power Conference paper "Optimal Power System Operation Analysis Techniques," Co-Author.

1977 London/Stockholm International Workshop on Instrumentation and Control of Water and Wastewater Systems paper, "Control and Monitoring of a Unique Wastewater System," Co-Author.

Unpublished thesis on "Electrostatic Unbalances of Double Circuit Transmission Lines."

ROGER G. OECHSEL
Assistant Head,
Foundations and Soil Mechanics Division,
Domestic Projects

Degree: Bachelor of Science in Civil Engineering
Northwestern University, 1960

Professional Engineer – Idaho and Illinois

Structural Engineer – Illinois

Professional Societies:

American Society of Civil Engineers
National Society of Professional Engineers

Harza Engineering Company since 1960.

Foundations and Soil Mechanics Division: Assistant Head, Domestic Projects, 1978 to date; Department Head, 1972-78; Section Head, 1968-72; Foundations, Soil Mechanics and Geology Division; Group Leader, 1965-68; Foundation and Embankment Department: Soils Engineer, 1960-65.

Experience Highlights:

Project Director for Beker Industries waste pond. Project entails design of waste pond reservoir from compacted gypsum for storage of fine mill tailings.

Project Manager for the Tilden Tailings Project, Michigan. Project includes an iron ore tailings retention reservoir and effluent treatment facilities. Work included feasibility study, exploration, design and construction.

Project Soils Engineer for the 2100-MW Bath County Pumped-Storage Project, Virginia, which includes two dams. One dam 500 feet high and 2500 feet long; the other 150 feet high and 2500 feet long.

Project Manager for the Meigs Mine project, Ohio, which includes two conveyor systems, two water supply dams and an ash retention dam, through field exploration, planning, design and resident engineering services during construction.

Project Manager for the improvement of the Barton, Argo, Geddes and Superior Dams, Huron River, for the City of Ann Arbor, Michigan; and for a feasibility study for the beautification of the Flint River, for the City of Flint, Michigan.

Project Manager for the repair of barge docking facilities, McIntosh, Alabama; and for a feasibility study on a phosphate slurry retention reservoir, Joliet, Illinois, for Olin Corporation.

Project Manager for the renovation of Lake Ellyn, which consisted of deepening the lake, stabilizing the shoreline, and providing a new pier and retaining wall for Glen Ellyn, Illinois; and for a feasibility study on the use of a sanitary landfill for a food distribution center for the Metropolitan Food Center, Illinois.

ROGER G. OECHSEL

Planned and supervised field investigations and wrote reports concerning pond stability including recommendations for remedial treatment and future pond development for the Olin Corporation, Joliet, Illinois, the Coastal Chemical Corp., Pascagulia, Mississippi, and Olin Corporation, Pasadena, Texas, waste disposal ponds.

Participated in foundation and embankment design, preparation of portions of contract documents and certain design memos for the 40-MW Rio Lindo project, Honduras.

Resident Engineer for a foundation exploration program for the 380-MW Seneca pumped-storage project, Pennsylvania. Also responsible for writing design memoranda and specifications for the foundation and embankment portion of the project; the design for the contract documents and portions of the construction drawings for the Upper Reservoir and Field Engineer during construction of the Upper Reservoir.

1957 to 1960:

Hazelet and Erdal; Chicago, Illinois.

Co-op student from Northwestern University. Made design studies on the freeway system for the State of Wisconsin. Worked as soils, concrete and pile inspector on the Illinois Tollroad.

HARZA ENGINEERING COMPANY

RUSSELL A. PAIGE
Geologist

Degrees: Master of Science In Geology
University of Washington, 1959
Bachelor of Science in Geology
University of Alaska, 1955

Languages: English and Spanish

Professional Geologist – California

Certified Engineering Geologist – California

Professional Societies:

Association of Engineering Geologists
Geological Society of America (Fellowship awarded in May 1972)

Harza Engineering Company since 1972.

Geological Division: Senior Geologist and Department Head, 1977 to date; Geologist, 1972-77.

Experience Highlights:

Responsible for the supervision and review of all assigned project geologic studies, planning, estimating, and supervision of exploration programs, preparation and review of reports, liaison with design and planning engineers; preparation of contract documents; and supervision and training of personnel.

Project experience as Department Head includes feasibility and design studies of the Nispero Hydroelectric Project, now in construction in Honduras; prefeasibility studies of the Remolino Hydroelectric Project in Honduras, design exploration and detailed studies at the San Lorenzo Hydroelectric Project, a large earthfill dam and generating station now in construction in El Salvador, Central America; prefeasibility studies at Brumley Gap and Powell Mountain, Virginia, two pumped-storage projects equal in magnitude and complexity to the Bath County Project.

Work and responsibilities on other projects have included regional and detailed site geologic mapping; planning, estimating, and supervision of exploration programs; core logging; water pressure testing; preparation of reports and contract documents; contract administration, reconnaissance evaluation of dam sites; and special studies of construction materials.

Resident Geologist for the following projects. Stony Creek feasibility studies for a large pumped-storage project in Pennsylvania; Bath County Pumped-Storage Project, Virginia, now under construction as the largest pumped-storage project in the U.S.; Patia Hydroelectric Project, Colombia, South America, feasibility studies for a complex project involving a 300-meter high rockfill dam, the Foothills Project, Colorado, involving design studies for a 265-foot high concrete arch dam; the Chimbo River Hydroelectric Project, Ecuador, including prefeasibility studies for regional and detailed geologic conditions for many sites throughout the Chimbo River Basin; the Uribante-Caparo Hydroelectric Project, Venezuela, including feasibility studies of four large earthfill and rockfill dams, several tunnels, and powerstations; and the Sula Valley Flood Control Project, which involved the evaluation of numerous damsites in northern Honduras.

RUSSELL A. PAIGE

1963 to 1972:

Polar Division, Naval Civil Engineering Laboratory, Port Hueneme, California.

Specialized in engineering geology 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 the strength properties and bearing capacity of sea ice for heavy cargo aircraft, docking areas, floating platforms, and other sea ice structures.

1962 to 1963:

Haner, Ross, and Sporseen, Consulting Engineers, Portland, Oregon.

Engineering Geologist. Responsible for geologic mapping of three dam sites, foundation and geologic studies for pipeline, canal, and irrigation projects. This work involved shallow-zone seismology, surveying, and supervision of core drilling programs.

1959 to 1962:

Peter Kiewit Sons Company, Vancouver, Washington.

Engineering Geologist. Duties consisted of classifying material on large excavation projects and helping to determine methods and costs of excavation. Shallow-zone seismology was extensively used in this work. Other duties included searches for sand, gravel, jetty stone, and rip rap.

1957 to 1959:

Graduate School, University of Washington.

Summer 1958:

Bureau of Public Roads, Fairbanks, Alaska.

Assistant Engineer. Road route geology, soils and materials classification, search and selection of construction material during road route location between Healy and McKinley Park and Eureka to Tanana, Alaska. Also did field work for MSc thesis.

1955 to 1957:

U.S. Geological Survey, Engineering Geology Branch, College, Alaska.

Geologist. Duties consisted of geologic mapping, reports, and research on frost action and permafrost.

Technical Papers and Articles:

"Floor Foundation Stabilization in Permafrost at Barrow, Alaska." Proceedings, Tenth Annual Symposium on Engineering Geology and Soils Engineering, University of Idaho, Moscow, Idaho, April 1972.

"Engineering Geology in the McMurdo Sound Region, Antarctica." Proceedings of the 1966 Annual Meeting, Association of Engineering Geologists, October 1966, also the Bulletin of the A.E.G., Vol. 4, No. 1, January 1967.

"Two Examples of Applied Engineering Geology. Mosier, Oregon, and Petersburg, Alaska." Proceedings of the 15th Alaskan Science Conference, University of Alaska, 1964.

"Frost Heaving of Piles with an Example from Fairbanks, Alaska." U.S. Geological Survey Bull. 1111-1, 1963 (co-author).

And numerous other technical papers.

WILLIAM L. PARTRIDGE
Senior Sociologist/Anthropologist

Degrees: Doctor of Philosophy in Anthropology
University of Florida, 1974
Master of Arts in Anthropology
University of Florida, 1969
Bachelor of Arts in Anthropology
University of Florida, 1966

Languages: English and Spanish

Professional Societies:

American Anthropological Association (Fellow)
American Ethnological Society
Council on Anthropology and Education
Current Anthropology (Associate)
Royal Anthropological Institute of Great Britain and Ireland (Fellow)
Society of Applied Anthropology (Fellow)
Southern Anthropological Association
Southwestern Anthropological Association

Harza Engineering Company since 1978.

Senior Sociologist/Anthropologist, Environmental Sciences Division, 1978 to date.

Experience Highlights:

Responsible for evaluating the social and cultural opportunities and impacts of resource development projects, and for planning programs to enhance benefits and minimize adverse effects. Supervise the planning and execution of socio-economic surveys and treatment of resulting data. Plan or review resettlement programs to ensure that human values are maintained in the course of project development.

1978:

National Science Foundation.

Co-principal investigator, "Mazatec Resettlement and Out-Migration," field work in southeastern Mexico on the impact of hydroelectric development.

1975 to 1978:

University of Southern California, Los Angeles.

Assistant Professor of Anthropology. Responsible for research in and teaching of Social Anthropology and Economic Development in Latin America.

1977 to 1978:

Pan American Health Organization.

Co-principal investigator and seminar leader, "Human Ecology and Health Impacts of the Aleman Dam, Papaloapan River Basin, Mexico."

WILLIAM L. PARTRIDGE

1976 and 1977:

Pan American Health Organization, Mexico City.

Temporary advisor to the Center for Human Ecology and Health.

1974 to 1975:

University of Southern California.

Visiting Assistant Professor of Anthropology. Responsible for research in and teaching of History of American Indians and Social Anthropology in Latin America.

1972 to 1974:

National Institute of Mental Health.

Predoctoral Research Fellow, field work in Colombia, South America.

1971 to 1972:

University of Florida.

Graduate Teaching Assistant, Department of Anthropology. Taught general anthropology course and conducted research on economic development in Latin America.

1969 to 1971:

University College, University of Florida.

Instructor. Social Sciences Department.

Books:

The Craft of Community Study, with Solon T. Kimball, University of Florida Press (in press).

Applied Anthropology in America, co-edited with Elizabeth M Eddy, Columbia University Press, New York, 1978.

The Hippie Ghetto. The Natural History of a Subculture, Holt, Rinehart and Winston, New York, 1973.

Technical Papers and Articles:

"The Papaloapan Dam and Resettlement Project," with A. B. Brown and J. Nugent, in Involuntary Migration and Resettlement, edited by T. Oliver-Smith and A. Hansen (in press).

"Banana County in the Wake of United Fruit: Social and Economic Linkages," American Ethnologist (in press).

"An Interdisciplinary Evaluation of the Human Ecology and Health Impacts of the Aleman Dam," with J. Nugent, A. B. Brown and J. Rees, available from Center for Human Ecology and Health, Pan American Health Organization, Havre 30, Mexico 1, D. F. Mexico, 1978.

"Development of Applied Anthropology in America," with Elizabeth M. Eddy, in Applied Anthropology in America, edited by E. M. Eddy and W. L. Partridge, Columbia University Press, New York, pp. 3-45, 1978.

"Comment on Voluntary Associations as Adaptive Mechanisms," in Current Anthropology 17(1), p. 41, 1976.

"Food Exchange Networks in a Tropical Plantation Community," paper presented at a symposium, Southern Anthropological Society, Clearwater, 1974.

HARZA ENGINEERING COMPANY

KNUT S. PLATOU
Senior Construction Engineer

Degrees: Bachelor of Science in Civil Engineering
University of Washington, 1957
Engineering Computer Application, Fortran
Continued Studies Program Diploma
University of Washington, 1967

Languages: English, German, Norwegian and knowledge of French

Professional Engineer – Washington

Professional Societies:

American Concrete Institute
American Society of Civil Engineers
Norwegian Society of Civil Engineers
United States Committee on Large Dams

Harza Engineering Company since 1972.

Construction Management Division: Senior Construction Engineer, 1972 to date.

Experience Highlights:

Engaged in construction design, conceptual planning and facilities analysis for the construction phase of hydroelectric and irrigation projects.

Provided similar services to clients for projects designed by others. Implemented computer simulation program for haul road and equipment efficiency. Providing source data on construction materials and methods for hydraulic structures. Researched state of the arts developments in flow induced vibrations. Researched and developed buoyant materials for patent rights. Researched state of the arts developments of oil spill and containment methods.

1969 to 1972:

Development and Resources Corporation, New York City, New York.

Senior Construction Engineer. Assigned to the Khuzestan Irrigation Project, Iran with overall supervision of inspection of all civil, mechanical, and electrical construction contracts for major regulating dam, diversion dam, and complete irrigation system. Responsibility included supervision of the checking of contractor's shop drawings, making field changes, and recommending major adjustments in contract plans to meet field conditions.

KNUT S. PLATOU

1965 to 1969:

Tacoma City Light, Tacoma, Washington.

Senior Office Engineer, Mossyrock Project with direct responsibility under Harza Engineering Company's Resident Engineer to organize and supervise office procedures, quantity control, structural, mechanical, electrical coordination, checkout of contractor's and manufacturer's drawings. Instigated data processing for quantity control and field engineering problems.

1964:

ETS Hokin Corporation, General Contractor, California.

South Fork American River Project. Participated in design evaluation of four hydroelectric power plants to establish design criteria to accommodate contractor furnished turbines and generators. Supervised drafting section.

1962 to 1964:

R. W. Beck and Associates, Seattle, Washington.

Senior Office Engineer, Packwood Hydroelectric Project. Provided field organization and services relating to high head plant with tunnels, pipelines and penstock features.

1962:

Vinnel Corporation, Alhambra, California.

Construction Engineer, Red Bluff Diversion Dam.

1957 to 1962:

L. E. Dixon, Arundel, Honkin Conkin Joint Ventures General Contractors, San Gabriel, California.

Construction Engineer on Rocky Reach 1st Stage Dam, Columbia River, Washington. Rocky Reach 2nd Stage 11-unit Powerhouse and Niagara Falls 10-unit Pumped-Storage Plant.

Assignments in construction engineering areas of large scale hydroelectric projects, such as lift sheets, form design, plant layout, cofferdam design, quantities, estimating, scheduling, cost control, claims evaluation and subcontractor coordination.

1945 to 1957:

Norwegian Navy, Electrician.
U. S. Army, Armored. Airplane mechanic.
Construction laborer, Alaska and Washington.

H. K. PRATT
Assistant to the Chief Engineer

Degree: Bachelor of Science in Civil Engineering
University of Minnesota, 1933

Professional Engineer – Alaska, British Columbia, California, Iowa, New York, Quebec, Washington, Wisconsin

Professional Societies:

American Society of Civil Engineers (Fellow and Life Member)
Past National Chairman, Hydraulics Division; Past Chairman, Committee on Hydraulic Structures
Association of Professional Engineers of British Columbia
Canadian National Committee on Large Dams (Past Chairman)
Canadian Society of Civil Engineers
Engineering Institute of Canada

Harza Engineering Company since 1977.

Assistant to the Chief Engineer, 1977 to date.

Experience Highlights:

Broad review of design of major dam and hydroelectric projects.

1974 to 1977:

Lalonde, Girouard, Letendre & Associates, Ltd., Montreal, Canada.

Advisor on design of portion of James Bay Hydroelectric Project, Quebec.

1965 to 1973:

British Columbia Hydro and Power Authority, Vancover, British Columbia.

Chief Engineer for four years. Also member of Board of Directors of International Power and Engineering Consultants. Retired 1973.

Associate Chief Engineer and Manager, Engineering Division. Duties included supervising generation, transmission and distribution of electricity throughout the Province.

Head, Hydroelectric Division of International Power and Engineering Consultants, wholly owned subsidiary of British Columbia Hydro and Power Authority. Responsibilities included supervising design and construction insepction of 600 foot high earthfill dam and 2,400,000 kW underground powerhouse, Portage Mountain project, Peace River, British Columbia.

H. K. PRATT

1963 to 1965:

R. W. Beck and Associates, Seattle, Washington.

Head, Design and Construction Department. Supervised West Coast design and construction activities of firm, including a high head hydroelectric project and two earth dams.

1961 to 1963:

Stanley Engineering Company, Muscatine, Iowa.

Chief Civil Engineer. Directed foundation investigation, surveys and feasibility study of Mt. Coffee Hydroelectric project, Liberia, West Africa. Also responsible for all civil engineering design for company.

1956 to 1961:

Bechtel Corporation, San Francisco, California.

Project Engineer. In charge of design for the Oroville-Wyandotte South Fork project, Feather River, California. Irrigation project consisting of 7 dams, 3 power plants, 20 miles of tunnel and 21 miles of irrigation and power canals.

1934 to 1956:

Corps of Engineers, United States Army.

Staff Hydraulic Engineer, St. Lawrence River Joint Board of Engineers. Review and approval of project design and construction of St. Lawrence Power and Seaway project, Ontario and New York.

Senior and Principal Engineer. Chief, Hydraulics and Reports Branch. Supervised hydraulic design of Garrison Dam and hydroelectric plant (400,000 kW).

Junior Engineer, Assistant Engineer, Associate Engineer and Engineer. Upper Mississippi Valley Division, St. Louis, Missouri. Engineering studies on dams, locks, levees, channel improvements and hydroelectric plants. Economic analyses and detailed hydraulic and hydrologic design studies.

Engineering-Aide. Maintenance and operation engineering studies, Upper Mississippi River Dams and Locks, St. Paul District, Minnesota.

Construction inspector, Fort Peck Dam, Missouri River, Montana.

RUSSELL W. REVELL
Senior Associate and
Chief Hydrologist

Degrees: Master of Science in Hydraulic Engineering
State University of Iowa, 1941
Bachelor of Science in Civil Engineering
Oregon State University, 1938

Languages: English and working knowledge of Spanish

Professional Engineer – Idaho and Illinois

Professional Societies:

American Geophysical Union
American Nuclear Society Working Group on Design Basis Flooding at Power Reactor Sites
American Society of Civil Engineers
Committee on Hydrometeorology, ASCE (1967-71; Chairman 1970-71)
Chairman, Task Committee on the Re-evaluation of the Adequacy of Spillways of Existing Dams, ASCE (1969-75)
American Water Resources Association (Charter Member)
International Water Resources Association
U.S. Committee on Large Dams of the International Commission on Large Dams
Western Snow Conference

Harza Engineering Company since 1956.

Senior Associate, 1976.

Associate, 1969.

Chief Hydrologist, 1967 to date, Hydrologist, 1962-67; Resident Manager, 1958-62; Office Engineer, Iraq, 1956-58.

Experience Highlights:

Responsible for quality of all work relating to surface hydrology, hydrometeorology, and flood control.

Resident Manager for the Hydrologic Survey of the Mekong River Basin, Vietnam, Laos, Cambodia, and Thailand, and for the Hydrological Survey of Iraq, Baghdad.

1953 to 1956:

U.S. Bureau of Reclamation, Columbia Basin Inter-Agency Committee; Portland, Oregon. Senior member of Technical Staff of Water Management Sub-Committee and Secretary of Power Planning Sub-Committee.

1949 to 1953:

U.S. Bureau of Reclamation; Boise, Idaho; Hydrologist.

RUSSELL W. REVELL

1946 to 1948:

U.S. Geological Survey, Water Resources Division; Boise, Idaho.

Assistant and Associate Engineer.

1942 to 1945:

U.S. Navy.
Squadron Aviation Ordnance Officer.

1938 to 1942:

U.S. Geological Survey, Water Resources Division; Iowa City, Iowa, Washington, D.C. and Los Angeles, California.

Junior and Assistant Engineer.

1938 to 1939:

State University of Iowa, Iowa City.

Research Assistant in charge of Ralston Creek Experimental Watershed.

Technical Papers and Articles:

"Re-evaluating Spillway Adequacy of Existing Dams," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 99, No. HY 2, February, 1973 (Task Committee Chairman and co-author).

Section 5 (Conveyance of Water in Natural Channels) HANDBOOK OF APPLIED HYDRAULICS, Third Edition (Davis and Sorensen, Editors), McGraw-Hill Book Company.

"The Effect of Freeboard on Evaporation from a Class A Evaporation Pan," Master's Thesis, 1941

"A Duration Curve Study of Willamette Valley Streams," Undergraduate Thesis, 1938.

"Use of Statistics in Runoff Forecasting," presented at Northwestern Regional Meeting of the American Geophysical Union, 1955.

"Experience with Water-Stage Servo-Manometer Gages in Southeast Asia," presented at the Second International Seminar on Field Methods and Equipment Used in Hydrology and Hydrometeorology, Bangkok, Thailand, 1961

HARZA ENGINEERING COMPANY

JOHN P. ROBINSON
Aquatic Ecologist/Fisheries Biologist

Degrees: Master of Science in Zoology
University of Wisconsin, 1973
Bachelor of Science in Biochemistry
Michigan State University, 1969

Languages: English and Spanish, reading knowledge of Portuguese and Italian

Professional Societies:

American Fisheries Society
American Society of Ichthyologists and Herpetologists

Harza Engineering Company since 1976.

Environmental Sciences Division. Aquatic Ecologist/Fisheries Biologist, 1976 to date.

Experience Highlights:

Evaluated potential impacts on aquatic organisms, including migratory salmonids, of development alternatives for additional generating capacity at five existing dams on the St. Joseph River, Michigan and Indiana.

Prepared detailed specifications for a two-year fisheries investigation program for the Yacyreta Hydroelectric Project, Argentina and Paraguay.

Monitored field studies and prepared aquatic ecology sections of Exhibits S (impacts on fish and wildlife resources) and W (environmental report) for Federal Energy Regulatory Commission license application for the Kootenai River Hydroelectric Project, Montana.

Identified potential impacts on fish and wildlife and on the esthetics and recreational use of the Missouri River for upgrading the water supply intake for the City of Williston, North Dakota.

Identified potential effects of hydropower generation flows on tailwaters fisheries and water quality at existing flood control dams in the Kanawha River Basin, West Virginia.

Studied aquatic plant conditions in Lake Yojoa, Honduras, to identify potential problems and their causes; recommended prevention and control measures for lake nutrient cycles.

Made recommendations for optimum design of the Lake Andes-Wagner Irrigation Project intake, Lake Francis Case (Missouri River), South Dakota, to minimize adverse effects on aquatic organisms.

Performed environmental field studies and made recommendations for mitigation of potential adverse impacts of the El Nispero Hydroelectric Project, Honduras.

Identified potential impacts on fisheries and wetlands resources and on public health of the Quimistan Valley Irrigation Project, Rio Chamelecon, and Sula Valley flood control works, Sula Valley Feasibility Studies and Ulua Basin Master Plan, Honduras; recommended mitigation measures and long-range environmental planning programs for the two watersheds.

JOHN P. ROBINSON

Identified design parameters, available biological data, and scope of aquatic studies required for compliance of an Illinois cooling water intake with federal (Section 316b, PL 92-500) and state requirements to minimize effects on aquatic organisms. Compared impacts of alternative intake sites and water pipeline routes on stream organisms.

Provided biological criteria for optimum design to minimize mortality of aquatic organisms for expansion of cooling water intake capacity at Commonwealth Edison Quad Cities and Dresden Nuclear Stations, Illinois.

Assisted in evaluating riverine and reservoir fisheries data, and in making recommendations for further investigative and fisheries management programs for the San Lorenzo Hydroelectric Project, Rio Lempa, El Salvador.

Evaluated the human use of riverine and marine aquatic resources in the project study area based on data obtained in Cairo, Alexandria, and Rome for the Qattara Hydroelectric Project, Egypt.

Evaluated the important freshwater shrimp and estuarine fisheries resources of the Lower Morass area for the Black River Upper Morass Irrigation Project, Jamaica, based on field investigations and data from secondary sources; also made recommendations for the conservation and management of aquatic resources in the Lower Morass.

1974 to 1976:

Smithsonian Institution/U.S. Peace Corps Environmental Program; Servicio de Recursos Pesqueros, Dirección General de Recursos Naturales, Ministerio de Agricultura y Ganadería, El Salvador, Central America.

Aquatic Biologist. Duties included planning and execution of fisheries and general biological surveys of major river systems. Made recommendations on resource use and conservation and on future investigative programs, with special emphasis on hydroelectric impoundments on the Rio Lempa.

1970 to 1973:

University of Wisconsin, Madison, Wisconsin.

Graduate Research. Responsible for all phases of coho salmon ultrasonic tracking program in Lake Michigan near Point Beach Nuclear Plant, Wisconsin; marine tracking of sockeye salmon near Prince Rupert, B.C., Canada; and a study of nearshore spawning movements of white bass, Lake Mendota, Wisconsin. Attended a course on miniaturized radiotelemetry systems and a marine research cruise, Cape Hatteras, North Carolina.

Technical Papers and Articles:

"Study of Spawning Migration of Coho Salmon (Oncorhynchus kisutch) in Lake Michigan Using Ultrasonic Transmitters," Master of Science Thesis (on file at Laboratory of Limnology, University of Wisconsin).

Three biological river survey reports from the Servicio de Recursos Pesqueros, Direccion General de Recursos Naturales, Ministerio de Agricultura y Ganaderia, Soyapango, El Salvador, Central America, in Spanish.

HARZA ENGINEERING COMPANY

HERBERT E. SCHOELLER
Assistant Head, Water Resources Division

Degree: Bachelor of Science in Civil Engineering (Hydraulics)
Stanford University, 1963

Languages: English, working knowledge of Spanish and Indonesian.

Professional Engineer — Illinois

Professional Societies:

American Society of Civil Engineers

Harza Engineering Company since 1966.

Water Resources Division: Assistant Head, 1977 to date; Head, Water Planning Department, 1974-76; Planning Engineer/Hydrologist, East Java, 1972-74; Water Resources Division: Hydraulic Engineer, 1970-72; Project Hydrologist, Thailand, 1968-70; Water Resources Division: Hydraulic Engineer, 1966-68.

Experience Highlights:

Planning Engineer/Hydrologist, East Java, Indonesia. Major responsibility for producing a feasibility study for irrigating 10,000 hectares of land, including coordination of geological, soils, agro-economic, and water supply investigations and designs for dam, diversion works, and conveyance facilities. Directed planning studies for selection of irrigation systems to be up-graded and hydrological studies for determining water requirements and available water supplies for development of operational procedures for irrigating about 230,000 hectares, principally riceland.

Project Manager for hydrologic environment, pollution abatement, flood control, and urban drainage studies.

Hydrologist, Colombia, on short-term assignment for training local engineers in preparing estimates of water supply and flood run-off for a screening study and feasibility study of potential hydroelectric development sites.

Planning Engineer/Hydrologist, East Java, for feasibility studies of rehabilitation of an irrigation system serving about 230,000 hectares of cultivated riceland.

Project Hydrologist, Bangkok, Thailand, feasibility studies of the Upper Nam Mun and Nam Chi Rivers. The project included studies for five storage reservoirs, two diversion dams, potential power generation and a distribution system serving about 60,000 hectares of irrigated area, primarily riceland.

Hydrologist, Guri Project, Venezuela, short-term assignment for hydro-meterological network review and reconnaissance study of flood warning system.

Hydrologist, Guinea, West Africa, feasibility studies for reclamation of coastal ricelands.

1963 to 1966:

International Engineering Company, San Francisco, California.

Associate Engineer, Hydrologist.

HERBERT E. SCHOELLER

1956 to 1963:

U.S. Geological Survey, Denver, Colorado.

Hydraulic Engineer Technician.

Technical Papers and Articles

"Problems of Inflow Design Flood Determination in the Tropics," (with Dr. R. A. Clark) ASCE National Water Resources Engineering Meeting, Memphis, Tennessee, 1970.

JOHN A. SCOVILLE, JR.
Vice-President

Degrees: Master of Science
Thayer School of Engineering, 1955
Bachelor of Arts
Dartmouth College, 1954

Professional Engineer — Illinois

Professional Societies:

American Society of Civil Engineers
British Geotechnical Society
International Society of Soil Mechanics and Foundation Engineers
International Water Resources Association
United States Committee on Large Dams

Harza Engineering Company since 1957.

Director, Harza Engineering Company International, 1974.

Vice President, Harza Engineering Company, 1968; Associate, 1967.

Deputy Director, Professional Staff Operations and Chief Soil Mechanics and Foundations Engineer, 1977 to date; Director, Eastern Hemisphere Management Group, 1976-77; Assistant Director, Eastern Hemisphere Management Group, 1973-76, Head, Special Services Branch, 1968-73; Assistant to Vice President, 1965-68. Indus Basin Division: Department Head, 1964-65; Acting Department Head, 1962-64. Soil Mechanics and Foundations Department: Section Head, 1960-62; Senior Engineer, 1957-60.

Experience Highlights:

Chief Soil Mechanics and Foundations Engineer responsible for review of complex problems in geotechnical engineering, establishing basic concepts for geotechnical investigation and design, and advice during construction and post-construction geotechnical monitoring of all projects.

Project Director of all the company's work in Iran, 1972-77. This included the 500-MW power plant and 200-meter high concrete arch dam for the Reza Shah Kabir Project the 38,000 hectare Gotvand Irrigation Project, and the 800-kilometers of 400-kV Karun transmission line and 4400-kV substations, through final design and construction; the 165-meter high rockfill Nader Shah Dam and the 55,500 hectare Behbehan Irrigation Project, during design, and the Electric Utility Management Project.

Project Director for the Jordan Valley Irrigation Project — Stage II (Jordan). Project involves a rockfill dam, powerplants, an 11,000 hectare irrigation project and conversion of an additional 11,000 hectares from gravity to sprinkler irrigation.

Project Director for Pakistan projects responsible for coordinating all technical and administrative activities of the Chicago Office with client needs.

JOHN A. SCOVILLE, JR.

Supervised and participated in the review of design, plans, and specifications for the 374-ft. high Mangla earthfill dam, and the 420-ft. high earth and rockfill Tarbela dam, Pakistan, and the 236-meter high rockfill Tachien dam, Taiwan.

1955 to 1957:

U.S. Army Corps of Engineers.
Enlisted rank classified as Civil Engineering Specialist.

1955:

Ohio Oil Company.
Junior Structural Engineer.

Technical Papers and Articles:

"Mangla Main Spillway, Design Features for Weak Foundations," with P. Sherlock, and A.R. Borges, published in transactions of 10th International Congress on Large Dams, 1969.

WILLIAM YING-JER SHIEH
Senior Associate and Head,
Structural Analysis and Design Division

Degrees: Doctor of Philosophy in Civil Engineering
Northwestern University, 1968
Master of Science in Civil Engineering
Lehigh University, 1958
Bachelor of Science in Civil Engineering
University of Illinois, 1956

Languages: English, Japanese, and Chinese

Professional Engineer – Illinois and California

Structural Engineer – Illinois

Professional Societies:

American Society of Civil Engineers
Fritz Laboratory Research Engineering Society
Illinois Society of Professional Engineers
National Society of Professional Engineers
The United States Committee On Large Dams.
Member of Earthquake Committee
Member of Maintenance, Operation & Safety Committee

Harza Engineering Company since 1959.

Senior Associate, 1978.

Associate, 1974.

Head, Structural Analysis and Design Division, 1974 to date. Applied Engineering-Mechanics Design Division Assistant Head, 1972-74; Head, Structural Department, 1967-72, Head, Structural Section, 1964-67; Structural Engineer, 1959-64.

Experience Highlights:

Responsible for supervision, design, and analysis of hydraulic structures such as concrete arch dams, penstocks, transmission towers, underground caverns, tunnel lining, and earth embankment structures, and for development and application of electronic computation programs for static and dynamic analysis of structures especially in usage of finite element methods.

Project Manager for the re-analysis of the San Dimas Dam and the Big Dalton Dam, California, by using the latest analytical method, and for designs for the 280-foot high thin arch Strontia Diversion Dam, Colorado.

Witnessing tower testing and reviewing tower designs for 115-kV transmission lines for the CEL System Expansion Project, El Salvador; for 230-kV transmission lines for the 100-MW Finchaa Project, Ethiopia; and for 400-kV transmission lines for the Karum EHV Transmission System, Iran.

Design of steel penstock for the 270-MW Cerron Grande Project, El Salvador, and for the 2,067-MW Guri Project, Venezuela.

Design of spillway training walls for the 2,067-MW Guri Project, Venezuela, and for spillway structures for the Pearl River Project, Mississippi.

Earthquake analyses for Braidwood cooling pond embankment for a nuclear power plant, Illinois, for the 85-meter high Cerron Grande fill dam, El Salvador; and for the 95-meter high Guri earthfill dam and the 110-meter high Guri rockfill dam, Venezuela.

Consultant to International Harvester Company, Illinois, on usage of computer program for structural analyses by finite element methods.

Design, analysis and review of model tests for the 200-meter high Reza Shah Kabir arch dam, Iran; for the 600-foot high Mossyrock arch dam, Washington; and vibration study for the 210-foot high Smith Mountain arch dam, Virginia.

1958 to 1959:

Vogt, Ivers & Associates, Cincinnati, Ohio.

Structural Engineer.

Technical Papers and Articles:

"Crown Cantilever Analysis of Arch Dam," with R.P. Wengler, Eighteenth Conference Bendix Users Exchange Organization Committee on Civil Engineer Application, Chicago, Illinois, 1960.

"Stress at the Base of Long Spillway and Other Cantilever Walls," with O. C. Zienkiewicz and J. A. Veltrop, International Congress of Large Dams, 1961.

Discussion of "Analysis of Circular Arches on Elastic Abutment," ASCE Trans., Vol. 128, Part II, 1963.

"Analysis of Plates by Finite Triangular Elements," with S. L. Lee and R. S. Parmalle, Journal of Engineering Mechanic Division, ASCE, Vol. 94, No. EM5, Proc. Paper 6176, October 1968.

"Application of Elasto-Plasticity of Rock Mechanics By Finite Element Method," with L. E. Baker and R. Sandhu, presented to the 11th Symposium On Rock Mechanics, Berkeley, California, 1969.

"Design of Mossyrock Arch Dam," with R. P. Wengler, published in Journal of The Power Division, ASCE, Vol. 97, No. PO1, January 1971.

"Application of Elasto-Plastic Analysis in Earth Structures," with R. Sandhu, presented at ASCE, Memphis National Water Resources Engineering Conference, January 1970.

"Stability and Dynamic Analyses of Cooling Tower," with C. H. Yeh, presented at ASME-IEEE Joint Power Generation Conference, Boston, Massachusetts, September 10 - 14, 1972.

"Safety Analysis of Concrete Dams Under Earthquake," with C. H. Yeh, Proceedings of an International Symposium on Criteria and Assumptions for Numerical Analysis of Dams, Swansea, U.K., September 8-11, 1975.

"Transient Seepage Analysis of Guri Earthfill Dam by Finite Element Method," with Chi-Yuan Wei, and Z. Pruza, presented at ASCE Spring Convention on The Use of Computers in Geotechnical Design and Construction, Pittsburgh, Pennsylvania, April 24-28, 1978.

and numerous other tehnical papers.

JOHN Q. SIMS
Engineering Geologist

Degree: Bachelor of Arts in Geology
University of California, Berkeley, 1958

Registered Geologist – California

Certified Engineering Geologist – California

Professional Societies:

American Geological Institute
Association of Engineering Geologist
Theta Tau – Engineering Fraternity
U.S. Committee on Large Dams

Harza Engineering Company since 1974.

Geology Division: Department Head, 1974 to date.

Experience Highlights:

Responsible for direction, review, and evaluation of geologic field and office studies and geologic reports carried out for planning, design and during construction of reservoirs, dams, tunnels, powerhouses and appurtenant structures.

Monitoring and general review of field work of resident geologist assigned to construction staff at Reza Shah Kabir 200 meter high concrete arch dam in Iran. Coordinate and assist in evaluation of results of geohydrologic monitoring program during reservoir filling.

Participated in the feasibility studies and exploration for design of the Uribante-Caparo project in Venezuela consisting of four embankment dams of height 120 meters and their associated tunnels, spillways, powerhouses and regulatory works for this large multipurpose project.

Supervision of field exploration and geologic studies for installation of permanent gated spillway in existing Kajakai Dam project, Afghanistan.

Responsible for planning of the design exploration drilling program and supervision of the geologic field studies for the 4040-MW Yacyreta-Apipe Project, Argentina.

Responsible for geologic review of the reanalysis of the existing San Dimas and Big Dalton Dams, California for seismic risk.

Responsible for planning and supervision of the feasibility and design phase field exploration programs and related office studies and reports for the Tavera-Bao and Tavera-Lopez Hydroelectric Projects, Dominican Republic.

JOHN Q. SIMS

1969 to 1974:

Tippetts-Abbett-McCarthy-Stratton, New York City, New York.

Principal Geologist for the Tarbela Dam Project, Pakistan. Responsible for design exploration and construction geology for entire project, which included three dams (470, 345, and 220 ft. high with a total of 186 million cubic yards of earth and rockfill), powerhouse (2100-MW), five tunnels (45 ft. I.D.), two spillways (7 and 9 gates), and numerous irrigation adits and canals. Responsible for evaluation of stability and reinforcement of cutslopes up to 700 ft. high, foundation inspection and treatment for all structures, excavation characteristics and support requirements for the large tunnels, classification of all earth and rock materials for use in civil works, and review of foundation grouting requirements and results of grouting. Developed construction geologic mapping techniques and trained staff of 30 Pakistani geologists to perform foundation inspection and mapping.

1968 to 1969:

State of California, Department of Water Resources, Palmdale, California.

Resident Geologist for Cedar Springs Dam and Tunnel. Responsible for foundation mapping, tunnel logging, and dam foundation grouting program for 330 ft. high earth and rockfill structure, including supervision of grouting inspectors.

1958 to 1968:

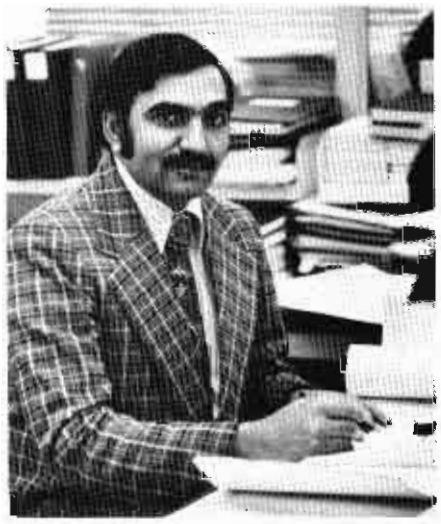
State of California, Department of Water Resources, Oroville, California.

Resident Geologist for Oroville Dam and Underground Powerhouse Project. Responsible for geologic interpretation and mapping for the relocation of 23 miles of major railroad from the reservoir through 5 long tunnels, relocation of State highway over four major steel and concrete bridges, construction of the 770 ft. high, 81 million cu. yd. dam and two downstream dams, two large diversion tunnels, a 600-MW underground powerhouse and smaller downstream powerhouse, large spillway, and canals. Responsible for design exploration and construction geologic mapping of all tunnels, dam foundations, and spillway foundation; review and inspection of rock bolting program, initiation of a seismitron rock noise monitoring program, evaluation of grouting results, and compilation of final geologic data reports on all features.

1954 to 1958:

University of California, Berkeley, California.

Student.



VIRENDRA SINGH
Geotechnical Engineer

Degrees: Master of Science in Civil Engineering
Illinois Institute of Technology, 1974
Bachelor of Science in Civil Engineering
University of Roorkee, Roorkee, India, 1967

Languages: English and Hindi

Professional Engineer – Illinois and California

Professional Societies:

American Railway Engineers Association
American Society of Civil Engineers
Illinois Society of Professional Engineers

Harza Engineering Company since 1977.

Foundations and Soil Mechanics Division. Geotechnical Engineer, 1977 to date.

Experience Highlights:

Responsibilities include all phases of geotechnical work from feasibility stage through the construction of the project, including preparation of design and contract documents, dam embankment stability analyses, and supervision of geotechnical and drafting personnel.

Responsible for preparation of construction drawings, quality control guidelines during construction, and instrumentation for the San Lorenzo Hydroelectric Project, El Salvador.

Responsible for geotechnical aspects of Sula Valley Flood Control Project and Quimistan Valley Irrigation Project, both in Honduras.

Performed alternate dam section design studies for a raisable rockfill dam, material usage and optimization studies, dam slope stability analyses, rock-cut slope stability analyses for spillway and appurtenant works, cost estimates, evaluation of performance characteristics of foundation and embankment material, foundation treatment studies, and site seismic studies for the Maqarin Hydroelectric Project, Jordan.

Conducted a stability analysis of an earthfill dam for static and pseudostatic conditions for the Guri Hydroelectric Project, Venezuela.

1973 to 1977:

Sargent & Lundy, Chicago, Illinois.

Senior Soils Engineer. Responsible for geotechnical work on four nuclear power plants and one fossil fuel plant. Responsibilities included supervision and direction of geotechnical personnel, project activity schedule, client/vendor contact, preparation and review of geotechnical reports, safety analysis reports (NRC guidelines) and quality assurance documents, surveillance, and evaluation of field activities.

VIRENDRA SINGH

1970 to 1973:

Chicago & Northwestern Railway Company, Chicago, Illinois.

Civil Engineer. Duties included surveillance of and maintenance programs for railway embankments and track structures, and office and field engineering for the structures.

1967 to 1970:

V. Singh & Company, Ghazibad, India.

Engineer responsible for design of retaining structures and foundations, and construction management for sewer line construction.

THOMAS S. SMALL
Electrical Engineer

Education

B.S.E.E., Electrical Engineering, University of Alaska, 1969
B.S.E.S., Engineering Science, University of Alaska, 1968
Post-Baccalaureate Courses in Engineering Management, Project Management, and Electrical Engineering

Experience

Mr. Small's recent work has been related to supplying the energy needs of rural Alaska communities. Projects include design and installation of a standby dual-fuel generator system for Nome, design of distribution facilities to replace those destroyed during a 1974 storm, and design and relocation of high-pressure gas mains and water and sewer lines.

Prior to employment with CH2M HILL, Mr. Small was utility manager and city engineer for the City of Nome Joint Utility System where he was responsible for preparing and administering the utility's budget. Other duties included operational supervision of a 5-megawatt diesel powerplant, design and maintenance of new distribution and transmission facilities, and maintenance and planning for sewer and water facilities. His responsibilities also included purchasing and supervising installation of three diesel generator systems.

As an engineer with Peter Kiewit & Sons, Mr. Small worked primarily as a utility engineer for heavy construction projects. Responsibilities included takeoff, scheduling, and relocation of telephone, electric, water and sewer systems.

Mr. Small is a captain in the Alaska National Guard. He has responsibility to support the communication needs of the 207th Arctic Recon Group. He has traveled to and worked with natives in more than 30 villages over the past 3 years.

Professional Engineer Registration

Alaska

Membership in Organizations

Institute of Electrical and Electronic Engineers
Northwest Public Power Association

Publications

1969, "Generation Facilities in the Tanana Valley," thesis, University of Alaska.

KENNETH E. SORENSEN
Vice-President and
Chief Planning Engineer

Degrees: Master of Science in Civil Engineering
University of Minnesota, 1946
Bachelor of Science in Civil Engineering
University of Minnesota, 1939

Professional Engineer – Maryland and Nova Scotia

Civil Engineer – Arizona

Structural Engineer – Minnesota

Professional Societies:

American Society of Civil Engineers
National Society of Professional Engineers
U.S. Committee on Large Dams
U.S. National Committee, World Energy Conference

Harza Engineering Company since 1946.

Director, 1971; Vice-President, 1963.

Principal Technical Advisor to the President, 1977; Director of Overseas Operations, 1976-77; Director of Latin American Operations, 1970-76; Head, Resources Development Branch, 1967-70; Chief Planning Engineer, 1964; Head, Planning Department, 1954-64; Structural Engineer, 1946-54.

Harza Engineering Company International: Chairman, 1977; President, 1974-77; Director, 1957.

Experience Highlights:

Responsible for most of the firm's appraisal, planning, and financing reports for the past 20 years. Some of the major hydroelectric projects include: 28,000-MW Inga Project on the Congo River; 10,000-MW development of the Caroni River in Venezuela; 4000-MW Yacyreta-Apipe Project on the Parana River; 2500-MW Priest Rapids–Wanapum development on the Columbia River; 1000-MW Reza Shah Kabir Project in Iran. Experience includes projects in more than 25 countries.

1942 to 1945:

U.S. Naval Construction Battalion.

Lt. (s.g.) CEC, U.S.N.R. active duty in Aleutian Islands and Philippines.

1940 to 1942:

Panama Canal, Office Engineering Division.

Structural Engineer.

KENNETH E. SORENSEN

1939 to 1940:

Kimberly Clark Corporation; Kimberly, Wisconsin.

Maintenance Engineer.

Technical Papers and Articles:

"Graphical Solution of Hydraulic Problems," ASCE Trans. Vol. 118, 1953, p. 61.

"Economic Planning for Stage Development," with Robert D. Jackson, ASCE Journal – Hydraulics Division, September, 1968, p. 1231.

"Underground Reservoirs: Pumped-Storage of the Future?," CIVIL ENGINEERING, March 1969.

"Reinforcing Steel for Penstock Wye Branches," Journal of the Power Division, Proceedings of the American Society of Civil Engineers, presented September 30 to October **4**, 1968.

"A Fourth Dimension for the Urban Environment," Journal of the Urban Planning and Development Division, ASCE, Vol. 97, No. UP1, Proc. Paper 8064, April, 1971, pp. 91-104.

Co-Editor "HANDBOOK OF APPLIED HYDRAULICS" – Third Edition, 1969. McGraw-Hill Book Company, Calvin V. Davis, Editor-in-Chief.

"Pumped-Storage Tidal Power," Tidal Power Proceedings, Halifax, Nova Scotia, Plenum Press, 1972.

HARZA ENGINEERING COMPANY

PHILIP S. STOFFEY
Assistant Concrete and Materials Engineer

Date of Birth:	December 10, 1944
Citizenship:	U.S.A.
Degrees:	Master of Science in Geohydrology 1968, University of Nebraska Bachelor of Science in Earth Science 1966, Eastern Kentucky University Graduate Courses in Soil Mechanics 1974, Northwestern University
Language:	English
Professional Registrations:	Professional Engineering Geologist, #E041, Oregon Certified Professional Geological Scientist #3848, National Certified Engineering Technician #046625, National
Professional Societies:	American Concrete Institute Association of Engineering Geologists North Dakota Geologists Twin City Geologists
August 1977 to Date:	Harza Engineering Company, Chicago, Illinois. Concrete and Materials Specialist. Foundations and Soil Mechanics Division. Responsible for evaluation of construction materials; preparation of specifications; establishing field quality control programs, assisting field forces on concrete and soils problems; preparation of a field guide to be used by soils engineers during soils investigations. Field assignments include supervision of rock drilling and program for tunnels and concrete aggregate; supervision of materials investigation for impervious material for earth fill dam; and concrete engineer for repair of spillway which used fiber reinforced concrete, expoxy mortar and included large scale industrial grinding. Major projects worked on include: El Nispero Project, Honduras, ENEE; Bath County Pumped-Storage Project, Virginia Electric and Power Company; Reza Shah Kabir Hydroelectric Project, Iran; Maqarin Project, Jordan; San Lorenzo Project, El Salvador; and Lock and Dam No. 1, Corps of Engineers, Minneapolis, Minnesota.

March 1977 to August 1977: Soil Testing Services of North Dakota, Bismarck, North Dakota. Office Manager. Responsibilities included promotion, managing the office, and handling operations in the field and laboratory.

Major projects included: Concrete testing for 400 kV Transmission Line for Commonwealth Associates; testing of concrete aggregate supply sources from various quarries throughout North Dakota for Concrete Products Company, Huron, South Dakota.

July 1976 to March 1977: Soil Testing Services of Minnesota, Minneapolis, Minnesota. Senior Engineering Geologist. Responsible for instrumentation including slope indicator, pressure meter, Whitmore strain gauge, and laboratory permeability tests. Responsible for soils and geologic investigations including drilling operations and reports; managed quality control department including field soil compaction and concrete testing.

Major projects worked on included: Soils, concrete and asphalt quality control for Litton Industries, Sioux Falls, South Dakota; pressure meter testing, Pillsbury Building, Minneapolis, Minnesota; transmission pole foundations, Northern States Power, Minneapolis, Minnesota; slope indicator and pore pressure tests for Evelith Taconite Company, Hibbing, Minnesota.

February 1970 to July 1976: Soil Testing Services, Inc., Northbrook, Illinois. Senior Engineering Geologist. Responsibilities involved instrumentation including seismic, resistivity, and vibration studies, direction of field drilling operations; soil report studies; chief field engineer on numerous quality control projects including inspection of concrete, caissons, slurry walls, piles and soil inspections.

Major projects included direction of drilling operations and a resistivity study for cavities in Arzew, Algeria for Pullman-Kellog; direct field drilling operations for Canadian Gypsum near Hagersville, Canada; direct drilling operations for an environmental land reclamation project near Sparta, Illinois for Consolidation Coal; seismic studies for Cleveland Cliffs Mining Company, near Ishpeming, Michigan and Corps of Engineers near Lemont, Illinois.

May 1970 to July 1972: Responsible for quality control including concrete pipe piles and concrete inspection for Social Security

May 1970 to July 1972: (Continued)	Building in Chicago, Illinois, and for all quality control and inspection including caissons - rock and hard pan, steel H-piles, slurry wall, and tie back system, and concrete including normal, lightweight, fly ash and expansive concrete at the Standard Oil Building in Chicago, Illinois.
August 1969 to February 1970:	Novak, Dempsey and Associates, Des Plaines, Illinois. Geologist. Responsibilities included quality control and testing of concrete and asphalt; technician on auger drill rig.
July 1968 to August 1969:	Texaco, Inc., Midland, Texas. Development and Exploration Geologist. Responsibilities included the making of geologic maps and cross sections for oil development and exploration in the Palo Duro Basin, Texas.

HARZA ENGINEERING COMPANY

ARTHUR H. STUKEY
Engineering Geologist

Degrees: Master of Science in Geology
University of New Mexico, 1968
Bachelor of Science in Geology
Tufts University, 1964

Languages: English and basic knowledge of French and Spanish

Professional Registrations:

Certified Professional Geological Scientist, No. 3930 (APGS)
Engineering Geologist, No. E146, Oregon

Professional Societies:

American Association of Petroleum Geologists
Association of Engineering Geologists
Association of Professional Geological Scientists
Geological Society of America

Harza Engineering Company in 1971 and since 1975.

Geology Division: Engineering Geologist, 1975 to date; Field Geologist, 1971.

Experience Highlights:

Conducts site and office evaluations of engineering geology related principally to construction of major hydroelectric projects, including the following:

Tavera-Bao Project, Dominican Republic (1979 to date): Responsibilities include site and office geologic work during construction phase of the 100-m high embankment dam and appurtenant structures; geologic review of grouting and drainage program; and a regional study to determine maximum credible earthquake (MCE). Responsible for final project geologic report.

Reza Shah Kabir Project, a 200-m high thin arch dam (1975-78). Resident Geologist (1975-77): Prepared final project geologic report, and coordinated hydrogeologic portion of operation and maintenance manual. Field duties included surface and subsurface structural and stratigraphic mapping during construction of cutoff wall, power tunnel stubs, and drainage galleries, revision of drainage curtain to accommodate geologic criteria; design of cored check holes for grout curtain, evaluation of drainage during first filling of reservoir, remedial grouting evaluations; rock slope stabilization; supervision of deep observation hole drilling and contract preparations; and implementation of geohydrological monitoring program.

Conducted office studies for Chicago Tunnel and Reservoir Plan (TARP), and provided geologic foundation mapping for Cornell Hydroelectric Plant, Cornell, Wisconsin (1975).

Conducted site geologic investigations during exploration phase for the Stony Creek Pumped-Storage Project, Pennsylvania (1971). Duties included core logging, pressure testing, and establishing stratigraphic correlations.

ARTHUR H. STUKEY

1970 to 1975:

Rutgers University, New Brunswick, New Jersey.

Graduate Student, Department of Geology. Worked intermittently during this period, as follows

Consultant, Rutgers Institute for Environmental Studies (August 1974 – January 1975). Geologist on multidisciplinary team reviewing, evaluating, and summarizing technical literature to prepare guidelines for local urban planning agencies throughout New Jersey.

Consultant, Madison Township Environmental Commission, New Jersey (January – June 1974). Compiled field and file data of geologic and hydrogeologic factors relevant to urban development south of New York City. Also responsible for public presentation of data and representing Commission in legal deposition.

Consultant, Rutgers Institute for Environmental Studies (August – December 1973). Collected geologic and groundwater data for land-use mapping study of glaciated, carbonate terrain in northern New Jersey.

Staff Geologist, Dames and Moore, Consulting Engineers, Cranford, New Jersey (September 1972 to July 1973). Primary assignment was to research and write structural geology portion of PSAR for Atlantic City, New Jersey, Offshore Nuclear Generating Station. Duties included map synthesis, literature research, and interviews with active researchers; supervising construction and evaluation of gravity and magnetic models of basement anomalies, and offshore and onshore regional structural analysis for an area enclosed by a 100-mile radius circle centered at the site.

Field Geologist, Dames and Moore (June – September 1971). Primary responsibilities included "split-spoon" soil sampling, stratigraphic correlation, marine geophysical survey evaluation, and regional geologic study for a subsurface fault investigation near a nuclear site in Maryland coastal plain.

Graduate Teaching Assistant (September 1970 – June 1971). Taught fundamental geologic principles in survey course, and developed laboratory and field exercises for undergraduate structural geology course.

1966 to 1970:

Texaco, Inc., Midland, Texas.

Exploration Geologist, Permian Basin of West Texas and New Mexico. Field responsibilities associated with exploration drilling included sample and mud logging, selecting casing points, core points, and drill stem test intervals, and overseeing mechanical logging (gamma-neutron, electric, and sonic well surveys). Office duties involved prospect generation utilizing subsurface geologic mapping techniques, geophysical coordination, and well log analysis, lease-rental evaluations, and regional geologic mapping.

HARZA ENGINEERING COMPANY

DAVID SULKOWSKI

Planning Engineer

Date of Birth:	September 2, 1953
Citizenship:	U. S. A.
Degree:	Bachelor of Science in Civil Engineering 1975, Michigan Technological University
Language:	English
Professional Society:	American Society of Civil Engineers (Associate Member)
Professional Registration:	Engineer-in-Training - Michigan
July 1977 to Date:	Harza Engineering Company, Chicago, Illinois. Engineer, Power Resources Division. Duties include work on the preparation of studies and reports for hydroelectric power, flood control, and related projects. Specific assignments are as follows: VEPCO Project: Project involved the development of a computer program to simulate the weekly operation, on an hourly basis, of the power system of the Virginia Electric and Power Company. Main work involved revisions to the computer program in order to fully utilize the energy storage of the Bath County Pumped-Storage project. Final work consisted of preparing a user's guide for the computer program.
December 1976 to June 1977:	Harza Engineering Company, Chicago, Illinois. Holtwood Generation Expansion Study. Project involved studies on expanding the existing Holtwood hydroelectric plant located on the Lower Susquehanna River for the Pennsylvania Power and Light Company. Main work included: backwater computations on the tailrace channel; evaluation of energy production for the existing power plant and the various expansion schemes; analysis of flashboard failures and their effect on energy production; quantity and cost estimates; economic analysis of alternatives; and report preparation. Fairview Pipeline Project: Project involved laying out the route of a 24-mile pipeline to supply make-up water for Illinois Power Company's 2500-MW thermal generating plant. Main work included layout of pipeline profiles, studies on economic pipe size diameter, and cost estimates.

June 1975 to November 1976: Harza Engineering Company, Chicago, Illinois. Burlington Dam - Souris River Flood Control Project. Interior drainage studies performed for the U.S. Army Corps of Engineers on several communities along the Souris River near Minot, North Dakota. Main work included: initial compilation of data; preliminary layout of alternatives; evalution of hydrologic parameters for use in computing rainfall runoff hydrographs and estimating streamflows; layout and preliminary design of selected alternative; hydraulic design of storm sewers, drainage conduits and diversion structures; storm routings; determination of pumping requirements - pump selection and operation; use of computer programs developed by the Corps for hydraulic computations; preparation of detailed cost estimates; and report preparation.

San Lorenzo Project, El Salvador. Work involved computations on river diversion; excavation, dam fill, and concrete quantities; construction schedules; and studies of road relocation in reservoir area. Also performed work for the Land Resources Division, including computations on earthwork, concrete quantities, channel depths and sump design for channel lift station.

May 1974 to September 1974: Landsco Design, Redford, Michigan. Draftsman. Responsibilities included interpreting client's blueprints in preparing picture process sheets for the 1976 Pontiac 4 and 6 cylinder engine block, updating tool layout sheets, and detailing of machine layouts.

JAMES H. THRALL
Head, Ecological Sciences Department

Degrees: Doctor of Philosophy in Biological Science
Illinois State University, 1972
Master of Science in Biological Science
St. Mary's College, 1967
Bachelor of Science in Biology
St. Mary's College, 1964

Languages: English, Spanish, and French (reading knowledge)

Professional Societies:

American Society of Icthyologists and Herpetologists
International Society for Tropical Ecology
North American Benthological Society

Harza Engineering Company since 1974.

Environmental Sciences Division: Aquatic Ecologist, 1974 to date.

Experience Highlights:

Supervises aquatic and terrestrial resource assessments and ecological impact analyses for both domestic and overseas projects. Designs and supervises basic fisheries investigations, including biological and socioeconomic field studies. Project Manager for both environmental and engineering/agricultural projects. Provides expert witness testimony to governmental and international agencies.

Project Manager for the international Puyango-Tumbes Irrigation Development Project (up to 140,000 hectares of irrigation development in Peru and Ecuador). Coordinated work of engineers, agronomists, economists and biologists, and supervised the preparation of a final report, in Spanish.

Environmental coordinator responsible for the preparation of an environmental assessment report for the 80,000-acre Lake Andes Irrigation Project in eastern South Dakota. Work included assessment of project impacts on terrestrial, wetland and aquatic habitats, development of recommendations for protecting and enhancing wildlife, fisheries and recreation resources, as well as recommendations concerning necessary steps for compliance with local, state, and federal regulatory guidelines.

Project Manager for the review study of the International Joint Commission's report on the Garrison Diversion Unit irrigation project in North Dakota. Prepared a review report and presented expert witness testimony before the International Joint Commission.

Supervised the preparation of a report on the riverine ecosystems to be affected by the Garrison Diversion Unit, as part of a study done for the Bureau of Reclamation.

Designed and supervised a year-long basic fisheries investigation in the Rio Lempa, El Salvador, as part of the feasibility studies of the San Lorenzo Hydroelectric Project. Work included biological, water quality and socioeconomic field studies.

JAMES H. THRALL

Performed fisheries assessments for hydroelectric development projects in Venezuela, Guyana, and Colombia.

1972 to 1974:

Peace Corps – Smithsonian Institute Environmental Program.

Worked with the Instituto de Desarrollo de Los Recursos Naturales Renovables (INDERENA) in Colombia, South America. Engaged in studies of the sabaleta, **Brycon henni,** a freshwater fish, including its life history, basic ecological investigations, as well as studies related to the development of this species for fish culture. Limnological studies on a newly formed reservoir of El Peñal and on the Porce River, Colombia. Advisor to the staff of INDERENA (a conservation agency of the Colombia government) in the planning of fish culture stations and future fisheries research projects. Taught an intensive, one-week course in aquatic ecology, attended by all INDERENA fisheries biologists.

1967 to 1972:

Illinois State University, Bloomington, Illinois.

National Science Foundation Research Fellow and Teaching Assistant in the Department of Biological Sciences. Doctoral dissertation research on the aquatic ecology of larval amphibians.

1966 to 1967:

St. Mary's College, Winona, Minnesota.

Master's candidate and teaching assistant. Master's thesis research on feeding and digestive physiology of freshwater mussels.

1964 to 1966:

Institute of Medical Technology, Minneapolis, Minnesota.

Instructor in anatomy and physiology.

Technical Papers and Articles:

"Alimento y Alimentacion de la Sabaleta (Characidae: **Brycon henni**) en el Rio Porce con Observaciones Sobre Alimentacion in Cautividad" Instituto de Desarrollo de Los Recursos Naturales Renovables. Medellin, Antioquia, Colombia, 1973.

"Peces de la Alta y Media Cuacha, Algunos Posibilidades Para Pisicultura." Instituto de Desarrollo de Los Recursos Naturales Renovables, Medellin, Antioquia, Colombia, 1973.

"Excavation of Pits by Juvenile **Rana catesbeiana,**" Copeia, 1971, pp. 751-752.

"An Albino DeKay's Snake (**Storeria dekayi wrightorum** Trapido) from Central Illinois." Transactions of the Illinois State Academy of Science, 1972, Vol. 64, No. 4, P. 400.

HARZA ENGINEERING COMPANY

ALEXIS C. VIRCOL
Power Planning Engineer

Date of Birth:	September 15, 1935
Citizenship:	Permanent Resident of U.S.A.
Degrees:	Master of Engineering in Hydroelectrical Engineering 1958, Polytechnical Institute of Bucharest, Bucharest, Rumania Graduate Courses in Applied Fluid Mechanics 1977-1979, Northwestern University, Evanston, Illinois
Languages:	English, French and Rumanian; reading ability in Spanish
Professional Registrations:	Professional Engineer - Illinois (1977) and Rumania (1966)
Professional Societies:	American Society of Civil Engineers International Water Resources Association
February 1978 to Date:	Harza Engineering Company, Chicago, Illinois. Power Planning Engineer. Power Resources Division. Assignments have included: economic evaluations of potential hydro-power alternatives at various existing multi-purpose dams in the Kanawha River Basin, West Virginia (both normalized cost and life-cycle cost analyses); design and cost estimates of spillways, fuse-plugs, lower level outlets for various upper and lower reservoirs included as alternatives in Brumley Gap Pumped-Storage Project, Virginia; economic evaluation of the thermal alternatives (oil-fired and woodchip-fired steam-electric plants) for a feasibility study of a hydro-power plant to be built at Itapeuara, Brazil, as well as present worth comparisons of equivalent alternative gravity dam schemes for the same project; economic assessment and comparison of various current and future technologies to satisfy future peak demands in the American Electric Power System for the U.S. Army Corps of Engineers; estimation of contractor's liquidated damages for late start-up of the Yacyreta Project in Argentina; evaluation of hydroelectric potential at the existing projects in the Ohio River Basin (mainly flood-control and recreation dams plus locks and dams); evaluation of powerplant extensions at the Priest Rapids and Wanapum Projects on the Columbia River, Washington.

February 1976 to February 1978: Harza Engineering Company, Chicago, Illinois. Planning Engineer. Resources Development Branch. Assignments have included: Design and cost estimate of a diffuser structure at D. H. Mitchell Power Station in Indiana; hydrologic analyses for the Guri Hydroelectric Power Project, Venezuela; determination of spillway and outlet design floods for the multi-purpose (irrigation, water supply, flood control) Kajakai Project in Afghanistan; determination of water supply availability and estimated drainage design discharges for the Black River Upper Morass Project, Jamaica; determination of hydraulic elements (water surface long-profiles and dike-elevations) for agricultural flood control in Jamaica, Upper Morass Project; water and salt budget analyses, determination of design floods for hydraulic structures, and prediction of lake level for Great Salt Lake, Utah; water availability studies, PMP and PMF analyses, and irrigation requirements for the Yarmouk River Project, Jordan; participation in determination of spillway and interconnection system design flood for the multi-purpose (irrigation, power, flood control) project at Tavera-Bao, Dominican Republic; hydraulic analyses for the surface water-control plan at the North Rawhide-Caballo surface coal mines, Carter Mining Company Project, Wyoming; hydraulic analyses for relocation requirements at the multi-purpose Kootenai Dam, Montana.

September 1963 to October 1975: Civil-Planning Hydrotechnical Design Institute, Bucharest, Rumania.
Design Engineer promoted to Head of Water Resources Systems Design Department in 1967. Directed a team of 40 engineers, designers and draftsmen.

Assignments included evaluation of regional water resources and needs, determinations of reservoir characteristics and performance, analyses of river basins for multi-stage development, cost evaluation of waterworks, economic studies and design of multi-purpose water resources systems. Important assignments were as: Project Manager for determining the optimum staged development of the Mures River Basin, under the United Nations Development Program; Project Manager for hydrological-hydraulic studies of the Danube River between Orsova and Tulcea for the Hydro-Power Plant, "Iron Gates."

May 1959 to September 1963: Research Hydrotechnical Institute, Bucharest, Rumania. Research Engineer. Duties included making hydrologic

May 1959 to September 1963: (Continued)	analyses of flood and drought frequencies, stochastic hydrology, reservoir sedimentation, spillway design floods and open-channel and reservoir flood-routing. Most important achievements were: a complete hydrologic survey of the Mures River Basin and a generalized study of flood peaks in Rumania, utilizing morphological data.
September 1958 to May 1959:	Hydro-Industrial Enterprise Co., Bucharest, Rumania. Junior Hydro-Civil Engineer. Duties included follow-up assignments during construction, erection-phase and final start-up of civil works such as earth-filled dams, hydro-power plants, channels, spillways and related items.
Technical Papers and Articles:	"Hydrological Studies on the Mures River Basin," I.S.C.H. Publications, Hydrological Series, Bucharest, Rumania, 1963.
	"Analysis of Flood Marks for Estimating the Flood Peaks," I.S.C.H. Publications, Hydrological Series, Bucharest, Rumania, 1962.
	"Application of the Risk-Uncertainty Theory in the Design of the Flood-Control System in the Crisul-Alb River Basin," Rev. Hidrologia, Meteorologia and Gospodarirea Apelor, 1969 (no. 2,), Bucharest, Rumania.
	"Use of Linear and Dynamic Programmation in Determining the Optimal Staged Development of Water Supply Works for Urban and Industrial Area of Brasov City," Rev. Hidrologia, Meteorologia & Gospodarirea Apelor, 1970 (no. 4), Bucharest Rumania.
	"General Equations for Drought-Curves of the Mures River at Arad Station and a Method of Estimating the Ground-Water Reservr," Rev. Hidrologia, Meteorlogia and Gospodarirea Apelor, 1965 (No. 1), Bucharest, Rumania.
	"Hydrotechnical Structures" (Handbook for technical high schools), coauthor, Ed. Didactica & Pedagogica, 1965, Bucharest, Rumania.

GEORGE V. VOLLAND
Department Head, Power Resources Division

Degrees: Bachelor of Mechanical Engineering
Union College, 1965
Bachelor of Arts in Economics
Union College, 1965

Languages: English and Spanish

Professional Engineer – Illinois

Professional Societies:

Illinois Society of Professional Engineers
National Society of Professional Engineers

Harza Engineering Company since 1967.

Power Resources Division. Department Head, 1977 to date; Planning Engineer, 1967-77.

Experience Highlights:

Project Manager for Brazil pumped-storage projects through prefeasibility study. Technical and cost studies were made of the following two projects: (1) the Cipo Project, which would develop a total head of about 550 meters and have an installed capacity of up to 6,000 MW in multiple stages, and (2) the Primavera Project, which would develop 1,000 MW utilizing a head of about 100 meters.

Project Manager for the Kootenai River Hydroelectric Project through license application to the Federal Energy Regulatory Commission (FERC). Responsible for preparation of FERC license application for the project, which would develop a capacity of 144 MW utilizing a head of about 28 meters.

Project Manager for the Tavera-Lopez Project, Dominican Republic, through feasibility report. Responsible for technical, economic, and financial studies leading to financing of the project which consists of the expansion of an 80-MW hydroelectric generating station and a 60-meter high reregulating dam and powerstation having an installed capacity of about 20 MW.

Project Manager for the Chimbo Project, Ecuador, through prefeasibility study. Responsible for coordination of studies leading to the identification, selection and technical and economic justification of a scheme for the development of the hydroelectric resources of the Chimbo River Basin, consisting of a 460-MW development in three powerstations including a 40-MW pumped-storage project.

Project Manager for the Betania Multipurpose Project in Colombia, through feasibility report. Responsible for preparation of alternative fill and concrete dam layouts and cost estimates, power operation studies, and economic evaluations.

Project Manager for the Santa Cruz System Expansion Project, Bolivia, through feasibility report leading to the technical and economic justification of the expansion of the system. The project consists of a 16-MW gas turbine generating plant and a 25-km, 69-kV transmission line and substations.

GEORGE V. VOLLAND

Assistant Project Manager for the 80-meter high rockfill dam and 270-MW Cerron Grande Project, El Salvador, through feasibility study; and for the expansion of the CEL system, El Salvador, responsible for power market analysis, evaluation of existing system, and economic analysis of future expansion programs.

Responsible for economic studies of water resource developments in the Gauley and Kanawha Basins in West Virginia.

Prepared power, energy, and cost analyses of the Corpus Project. Studies included analyses of reservoir elevations and sites for a proposed 2,000-MW to 9,000-MW hydroelectric development on the Parana River between Argentina and Paraguay.

Prepared economic evaluations of a 3-project, 1,200-MW development for the Uribante and Caparo Basins in Venezuela.

Prepared economic and financial analyses of 4,050-MW Yacyreta Project on the Parana River between Argentina and Paraguay.

Prepared a 30-year financial forecast for the Blue Mountain Water Supply Project, Jamaica, as a part of the feasibility study to support loan application to international lending agencies.

Responsible for the economic justification and layout and cost estimates for the rehabilitation and expansion of the distribution system for the City of Medan, North Sumatra, Indonesia, through the feasibility study.

Participated in system load flow studies and design for the West Pakistan Power Consulting Services; power market survey for Southern Bolivia, a 10-year financial forecast for the Empresa Nacional de Electricidad, Bolivia; evaluation of thermal electric plants for the Potosi Electric Power Supply Project, Bolivia, and the financial analysis, layout and cost estimates of earthfill dams for 250-MW Lake Havasu Pumped-Storage Project, Arizona.

1965 to 1967:

U.S. Peace Corps, Ecuador.

Resident Engineer for the Ecuadorian Institute of Electrification. Responsible for distribution system construction and maintenance, and for construction of small diesel generating plant.

Technical Papers and Articles:

"An Introduction to Physical Analogues in Economics," unpublished thesis.

BI-HUEI WANG
Associate and Assistant Chief Hydrologist

Degrees: Doctor of Philosophy in Hydrology
Utah State University, 1970
Master of Engineering in Hydraulics
Asian Institute of Technology
Bangkok, Thailand, 1967
Bachelor of Science in Agricultural Engineering
Taiwan University, Taipei, Taiwan, 1955

Languages: English, Chinese, and Japanese

Professional Engineer – Taiwan

Professional Societies:

American Geophysical Union
American Society of Civil Engineers
(Committee Chairman, Surface Water Hydrology)
American Society of Mining Engineers

Harza Engineering Company since 1972.

Associate and Assistant Chief Hydrologist, 1979.

Hydrology Division: Assistant Head, 1978 to date, Head, Hydrology Department, 1973-78; Senior Hydrologist, 1972-73.

Experience Highlights:

As Assistant Chief Hydrologist, reviews hydrologic analyses of all types for quality of analyses and results.

As Assistant Head of the Hydrology Division, directs, supervises, and performs hydrologic analyses of all types, such as determination of spillway design floods, flood frequency analyses, determination of dependable water yield, stochastic hydrology, sediment analyses, and mathematical simulation of water resources systems.

Directed comprehensive hydrologic analyses for the San Lorenzo hydroelectric project in El Salvador, the Jordan Valley irrigation and hydropower project in Jordan, the Black River Upper Morass irrigation and drainage project in Jamaica, and the Northeastern Honduras hydroelectric site survey in Honduras.

Directed probable maximum flood analyses and reservoir operation studies for the Kajakai irrigation, hydroelectric, and flood control project in Afghanistan.

Participated at review level capacity in the comprehensive hydrologic studies for the Betania and Sogamoso hydroelectric projects in Colombia, Guri and Uribante-Caparo hydroelectric projects in Venezuela, Chimbo hydroelectric project in Ecuador, and Puyango-Tumbes irrigation and hydroelectric project in Peru and Ecuador.

Project Manager for review of flood analyses for the Allens Creek nuclear power project, Texas, and the Quanicassee nuclear power project, Michigan, for the U.S. Atomic Energy Commission.

BI-HUEI WANG

Project Manager for a study of water supply and demand relationship for a proposed lignite fuel power project, North Dakota.

Project Manager for development of the Caroni River streamflow forecasting system in Venezuela.

Directed thermal discharge and supplementary cooling studies for Dean H. Mitchell Station in Indiana for the Northern Indiana Public Service Company and hydrothermal modeling for Black Dog Station in Minnesota for Northern States Power Company.

Directed flood and low flow analyses for the 1710-MW Stony Creek pumped-storage project, Pennsylvania, in connection with FPC license application.

Estimated the reservoir sediment deposition and downstream degradation for the Foothills Water Supply Project, Colorado, and the Powder River Water Supply Project, Wyoming.

Directed flood operation study for Bath County Pumped-Storage Project in Virginia and dam failure analyses for Piney Project in Pennsylvania.

1967 to 1972:

Utah State University, Logan, Utah.

Teaching Assistant, Research Assistant, and Research Engineer. Assignments included the following: instructing hydraulic experiments; directing graduate students' research programs toward M.S. and Ph.D. degrees, and development of mathematical models and computer programs for simulating hydrologic and water resources systems.

1967:

U.S. Bureau of Reclamation, Bangkok, Thailand.

Civil Engineer. Pamong Project. Assignments included determination of irrigation requirements, computer programming, and comprehensive water resources development planning.

1966 to 1967:

SEATO Graduate School of Engineering (presently Asian Institute of Technology), Bangkok, Thailand.

Graduate Assistant and Research Associate. Duties included research in hydrology and instruction of graduate hydraulic experiments.

1956 to 1965:

Taiwan Water Conservancy Bureau, Taipei, Taiwan.

Junior Engineer, Associate Engineer; Chief, Survey and Design Team, Shih-men. Rotation Irrigation Project. Assignments included the following: hydraulic and structural design of irrigation and drainage structures, hydrologic and economic analyses of drainage and tide prevention projects; and supervision and review of water resources development projects of all type. Was honored by the Governor of Taiwan in 1959 and was awarded the Outstanding Engineer Award by Taiwan Water Conservancy Bureau in 1963.

Technical Paper and Articles:

"Insolation on Natural Watershed," M. Engineering Thesis, SEATO Graduate School of Engineering, Bangkok, Thailand, 1967.

"Influence of Mountain Groundwater on Streamflow," with Roland W. Jeppson, Utah Water Research Laboratory, Utah State University, Logan, Utah, 1970.

"Combined Surface Water – Groundwater Analysis of Hydrological System with the Aid of the Hybrid Computer," with W.J. Morris, N.W. Morgan, and J.P. Riley, American Water Resources Association Conference, Las Vegas, Nevada, November 1970.

"Evaporation from Shallow Lake," with J.P. Riley, American Water Resources Association Conference, Washington, D.C., October 1971.

"Hybrid Computer Simulation of Groundwater Regimes," Fall Annual Meeting of the American Geophysical Union, San Francisco, December 1971.

"Water Resources Management Model, Upper Jordan River Drainage, Utah," with Felix, Gold, Jones, and Riley, Utah Water Research Laboratory, Utah State University, Logan, Utah, March 1973.

LEEI-LUOH WANG
Power Planning Engineer,
Power Resources Division,
Resources Development Branch

Degrees: Master of Science in Civil Engineering
Utah State University, 1966
Bachelor of Science in Agricultural
Engineering, Hydraulic Section
National Taiwan University, China, 1958

Languages: English and Chinese

Professional Engineer — Illinois

Harza Engineering Company since 1966.

Power Planning Engineer, Power Resources Division, 1971 to date, Planning Engineer, Water Resources Division, 1966-71.

Experience Highlights:

Supervise the planning studies of assigned hydroelectric and other projects. Also act as Project Manager for some of these projects. In this capacity, prepare budget, work schedules and reports; coordinate work assignments; monitor cost and progress; and maintain liaison with client.

Project Manager for prefeasibility study of the 800-MW Cuffs Run Pumped-Storage Project, Pennsylvania; augmentation reservoir siting study, Pennsylvania and Maryland; feasibility studies of expansion of Lower Susquehanna powerplant, Pennsylvania, including the 230-MW Safe Harbor Project and the 108-MW Holtwood Project; load dispatch study of the Virginia Electric and Power Company's System, Virginia; and the technical feasibility study of the 1,800-MW Sogamoso Project, Colombia.

Project Manager for storm drainage studies, Village of Kenilworth, Illinois; probable maximum flood studies at Monticello Nuclear Power Station, Minnesota; radioactive pollutant dispersion study for Zimmer Station, Ohio; and the Columbus Flood Plan Study, Indiana.

Power System Specialist to National Power Company, Iceland. Supervised power system study for the Thjorsa Basin that included two existing powerplants, five potential reservoirs, ten proposed hydroelectric plants, a pumping station, and various diversion schemes.

Participated in studies of the Puyango-Tumbes Basin Development, Ecuador-Peru; the Parana River development, Corpus Project, Argentina; the 10,000-MW Guri Hydroelectric Project, Venezuela; and the 1,500-MW Patia Hydroelectric Project, Colombia.

1966:

Utah Water Research Laboratory, Utah State University, Logan, Utah.

Graduate Research Assistant on a project to develop a plan for the water needs of the State of Utah.

LEEI-LUOH WANG

1964 to 1965:

International Engineering Company, San Francisco, California.

Assistant Engineer.

Worked on a series of feasibility studies for hydroelectric and irrigation projects in Tunisia and Turkey.

1962 to 1964:

Utah State University, Logan, Utah.

Graduate Student. Worked for Utah State Department of Highways as Soils Engineer during the summer, conducting soil analyses and site investigations for interstate highway projects.

1959 to 1962:

Taiwan Provincial Water Conservancy Bureau, Taipei, Taiwan.

Junior Irrigation Engineer, Planning Division.

1958 to 1959:

Chinese Air Force.

Engineer Officer.

Technical Papers and Articles:

"Application of Multivariate Analysis in Predicting the Water Yields in Utah," unpublished thesis.

"Estimating Water Yields in Utah by Principal Component Analysis," with A.L. Huber, Utah Water Research Laboratory Report PRWG 35 a-1, June 1967.

HARZA ENGINEERING COMPANY

RALPH L. WATT, JR.
Civil Engineer

Date of Birth:	August 1, 1953
Citizenship:	U.S.A.
Degree:	Bachelor of Science in Civil Engineering 1977, University of Illinois
Language:	English
Professional Registration:	Engineer-in-Training - Illinois
Professional Societies:	American Society of Civil Engineers Illinois Society of Professional Engineers Western Society of Engineers
Certification:	O.S.H.A. Construction Supervisor
January 1977 to Date:	Harza Engineering Company, Chicago, Illinois. Engineer. Scheduling Department, Construction Division. Responsible for studies of construction methods, construction scheduling, manpower analysis, equipment selection, network design, CPM data processing and updating on the following projects: Lyallpur-Multan-Guddu 500-kV Transmission Line and Substation, Pakistan; Wastewater Treatment Facilities at the Will County, Kincaid, Ridgeland, Quad Cities, Dresden, and Zion Power Stations, all in Illinois; Quad Cities Power Station Intake Structures, Illinois; renovation of Lock and Dam No. 1, Minnesota; San Lorenzo Hydroelectric Project, El Salvador; Itapueara Hydroelectric Project, Brazil; Burlington Flood Control Project, North Dakota; Maqarin Diversion Project, Jordan; and Yacyreta Hydroelectric Project, Argentina and Paraguay.
June 1975 to August 1975:	City of Naperville, Naperville, Illinois. Inspector. Public Works, Engineering Department. Responsibilities included inspection and functioning as owner's representative on various construction projects.

March 1979

R. P. WENGLER
Vice President and Head,
Advanced Structural &
Hydraulic Branch

Degrees: Master of Science in Civil Engineering
University of Minnesota, 1954
Bachelor of Science in Civil Engineering
University of Minnesota, 1952
Bachelor of Business Administration
University of Minnesota, 1952

Languages: English, German and working knowledge of French

Professional Engineer -- Alaska, California, Colorado, Florida and Illinois

Structural Engineer – Illinois

Professional Societies:

American Concrete Institute
American Nuclear Society
American Society of Civil Engineers
Earthquake Engineering Research Institute
United States Commission on Large Dams

Harza Engineering Company since 1954.

Vice President, 1978.

Senior Associate, 1976.

Associate, 1967.

Head, Advanced Hydraulic and Structural Branch, 1976 to date; Head, Applied Engineering and Mechanics Division, 1969-76; Civil Design Branch: Head, Structural Design Department, 1967-69; Head, Civil Department, 1964-67; Assistant Section Head and Section Head, 1960-64; Group Leader, 1957-59; Senior Engineer and Assistant Group Leader, 1956; Junior Engineer, 1954-55.

Experience Highlights:

Responsible for supervision of the divisions assigned to the Advanced Structural and Hydraulic Branch. These divisions design and prepare drawings for a wide variety of structures including arch dams, spillways, transmission towers, substations, bridges, post-tensioned gate anchor systems, penstocks and nuclear plants. To support these designs, continuing effort is made to improve computer programs for analysis of structural and hydraulic problems with "State of the Art" techniques.

Project assignments have progressed from trial load analysis of the 250-ft. Mayfield arch dam in Washington through analysis and design of the 178-meter Karadj arch dam, Iran; 606-ft. Mossyrock arch dam, Washington; and supervision of the design of the 200-meter Reza Shah Kabir arch dam, Iran.

R. P. WENGLER

Member of Consulting Board of Farraday Dam, Oregon.

Technical Papers and Articles:

"Analysis of Arch Dams on G-15 Computer," by Wengler and Veltrop, Fourth Annual G-15 Users Exchange Conference.

"Buttress Dam Design by Electronic Computer," by Wengler and Veltrop, Symposium on Analysis and Design of Hydraulic Structures, Indiana Institute of Science, 1962.

"Crown Cantilever Analysis of Arch Dams," by Wengler and Shieh, Eighteenth Conference Bendix Users Exchange Organization.

"Design of Karadj Arch Dam," by Wengler and Veltrop, Journal of Power Division, ASCE, March 1964.

"Structural Behavior of Karadj Arch Dam," by Veltrop, Wengler and Azri. Eighth International Congress on Large Dams, Edinburgh, May, 1964.

"Computers as a Tool in Planning Hydraulic Structures," by R. P. Wengler, ASCE Annual Meeting and Environmental Engineering Conference, Kansas City, October, 1965.

"Section 14 – Arch Dams," by Houk and Wengler, HANDBOOK OF APPLIED HYDRAULICS, Third Edition.

"Design of Mossyrock Arch Dam," by R. P. Wengler and W. Y. Shieh, ASCE National Structural Meeting, Portland, Oregon, April 1970.

"Effect of Safety Factor and Concrete Strength on Cost of Arch Dams," by R. P. Wengler, Proceedings of the Engineer Foundation Research Conference – Rapid Construction of Concrete Dams, Asilomar, California, March 1970.

"Safety of Dams – Design Considerations," by R. P. Wengler, Hydraulic Power Committee Meeting, Edison Electric Institute, Lake of the Ozarks, Missouri, May 1977.

JACK WEST

- Numerous engineering studies, analyses, purchase specifications, and negotiations for various Alaskan utilities.

- Multiple small hydroelectric (10-30 MW) feasibility studies and investigative field work (site inspections economic analysis, hydrology, load projections, etc.) for Alaskan municipal and REA electric utilities.

- Extensive remote areas engineering for RCA Alaska Communications and the national defense (White Alice) systems.

Prior to joining CH2M HILL, Mr. West was principal of Jack West Associates, a private consulting firm. In earlier Alaska years he was a staff engineer with RCA Service Company, RCA Alaska Communications, and an Associate Engineer with Robert W. Retherford Associates Consulting Engineers. In Missouri and Kansas, Mr. West was an engineer for Black and Veatch, Burns McDonnell, and J. F. Pritchard Construction Engineers.

Mr. West has supplemented his professional background with extensive world travel often professionally related. An example was 1974 travel to Israel for familiarization and training on exotic vapor turbines playing a critical role in the operation of the Trans-Alaska pipeline. Other travel has included all provinces and territories of Canada, Denmark, Norway, Switzerland, Kenya and Tanzania (East Africa), France, Jamaica, Belize (Central America), and Mexico.

Professional Registration

Alaska

JACK WEST
Senior Consultant

Education

B.S., Electrical Engineering, University of Kansas, 1961
Post graduate course work, University of Alaska and University of Oregon extensions

Experience

Practicing in Alaska for 16 years, Mr. West has designed and construction-managed electric power and control projects of a wide variety. Included in these projects are diesel and gas turbine generation, transmission and distribution lines, substations, remote communications systems, and complex industrial control and instrumentation systems. Prior to Alaska Mr. West participated in electrical and fluid mechanics design of hydrocarbon refineries and gas liquefaction plants for a construction engineering firm. Alaska experience includes the following:

- Special consultant to Alyeska Pipeline Service Company for startup and first year of pipeline operation. Responsible for startup of all 62 remote mainline gate valves full length of pipeline. Extensive control, control power, and instrumentation work at all pump stations and Valdez remote control center.
- Special consultant to RCA Alaska Communications designing prototype remote unattended power systems for 27 microwave sites controlling the Alaska Pipeline from the Valdez control center.
- Design, construction management, and startup of diesel/gas turbine generating units throughout Alaska.
- Consulting on generation control (voltage regulation, speed governing, etc.) throughout Alaska.
- Design and resident engineering on substations, distribution lines and equipment, and transmission lines to 138 kV.
- Design and implacement of a 4-mile-long, 100-ton, 25-kV submarine cable.
- Supervision of retrieval, repair, and replacement of damaged 1.5-mile, 15-kV submarine cables.

HARZA ENGINEERING COMPANY

RICHARD A. WESTMORE
Water Resources Planning Engineer

Degrees: Master of Science in Water Resources Management
University of Wisconsin, 1971
Bachelor of Science in Civil Engineering
University of Wisconsin, 1970

Professional Engineer – Illinois

Professional Society:

American Society of Civil Engineers

Harza Engineering Company since 1971.

Water Resources Division: Water Resources Planning Engineer, 1973 to date. Flood Control Engineer, Pakistan, 1975. Sanitary Engineering Division: Civil Engineer, 1971-73.

Experience Highlights:

Planning Engineer for feasibility study of upgrading five existing low-head hydroelectric projects on the St. Joseph River in Indiana and Michigan, and for review of operating procedures for a small hydro project in Upper Michigan. Work included capacity and energy studies, evaluation of alternatives for upgrading the plants, and preparation of planning reports.

Planning Engineer for hydraulic study of a proposed floodway for the Sula Valley Flood Control Project, Honduras.

Project Manager for the City of Williston, North Dakota, Water Supply Study. Work involved evaluation of alternative measures to improve the city's raw-water supply system.

Project Manager for the City of Sioux Falls, South Dakota, Water Supply Alternatives Study, involving evaluation of ground-water supply alternatives, updating of cost estimates for surface-water supply alternatives, and appraisal of treatment plant requirements.

Planning Engineer on resident assignment in the Norte Grande Region, Chile. Prepared water-demand forecasts, formulated and costed alternative water supply plans, and prepared sections of the planning report.

Project Manager for flood insurance studies for seven communities and unincorporated areas in two counties in Illinois, for the Department of Housing and Urban Development, Federal Insurance Administration. Planned, conducted, and supervised hydrologic and hydraulic analyses to develop water surface profiles for floods of various frequencies using computer simulation methods. Participated in public meetings, floodway negotiations, and project coordination and management activities.

Flood Control Engineer on resident overseas staff for flood control engineering services to the Government of Pakistan. The project involved appraisal of the existing flood forecasting and flood warning systems and the current flood control facilities throughout the country, and development of a comprehensive program for improvements.

RICHARD A. WESTMORE

Project Manager for Inventory of Urban Water Damages in the Chicago Metropolitan Area, a study of the causes and magnitude of overbank flood and stormwater drainage damages in 60 communities located along 20 watercourses in Cook and DuPage Counties, Illinois.

Assistant Project Manager for the Greater Egypt Regional Water Systems Study. The project involved preparation of a master plan for phased expansion of four regional water systems and recommendation of policy-level guidelines for system management.

Performed bench-scale treatability studies and laboratory tests, over a four-month period, for a joint municipal-industrial wastewater treatment project for the City of Oconto Falls, Wisconsin, and the Scott Paper Company.

Other assignments have included preparation of design criteria, conceptual designs and layouts, quantity and cost estimates, economic analyses, and report drafts and memoranda for regional planning projects. Projects in this field included the Regional Sanitary Sewerage Plan for the seven-county Southeastern Wisconsin Region, the Pike River Watershed Sewerage Plan for a 50-square mile area in Wisconsin, and an interim Water Quality Management Plan for a three-county area in Illinois.

1970 to 1971:

University of Wisconsin.

Teaching Assistant in Water Resources Engineering and in Fluid Mechanics. Assigned as a Research Assistant to undertake surveying and stream-gaging for a research project in the study of thermal and treated sewage effluent mixing zones.

Technical Papers and Articles:

"An Analysis of the Enforcement Conference Procedure in Achieving Water Pollution Abatement in Lakes Michigan and Superior," unpublished, 1971.

"An Up-dated Look at the TVA as an Institution: Its Policies and Programs," unpublished, 1971.

"Water Resources Education Requirements of an Engineering Firm," with Alan H. Schultz, presented at the ASCE National Convention, Chicago, Illinois, October 1978, and accepted for publication in the Journal of the Water Resources Planning and Management Division (ASCE), September 1979.

CLIFFORD L. WILLIS
Vice-President and
Chief Geologist

Degrees: Doctor of Philosophy (Geology)
University of Washington, 1950
Bachelor of Science Mining (Geology) Engineering
University of Kansas, 1939

Honorary Societies:

Tau Beta Pi, Sigma Tau, and Sigma Xi

Honors:

Haworth Distinguished Alumnus Award for the University of Kansas

Listed:

American Men of Science
Dictionary of International Biography
Who's Who in Engineering

Professional Societies:

American Institute of Mining, Metallurgical and Petroleum Engineers
American Association of Petroleum Geologists
Association of Engineering Geologists
International Society of Rock Mechanics
Geological Society of America (Fellow)
Geological Society of London (Fellow)

Harza Engineering Company since 1952.

Vice-President, 1967; Associate, 1957.

Chief Geologist, 1954; Consulting Geologist, 1952.

Experience Highlights:

Responsible for geological investigations and interpretations on company assignments. Provides advisory services and special consultation to clients. Major projects have included, among others, the Mangla and Tarbela Projects on the Indus Basin development, West Pakistan, totalling more than 250 million cubic yards in the volumes of the two dams and more than $1 billion in construction cost; Reza Shah Kabir (200-m) and Karadj (178-m) arch dams, Iran; Mossyrock (606-ft.) arch dam, Washington; and the Wanapum and Priest Rapids hydroelectric projects on the Columbia River, Washington; and the 10,087 MW Guri project on the Caroni River, Venezuela.

1946 to 1954:

University of Washington, Department of Geology; Seattle, Washington.

Assistant Professor.

CLIFFORD L. WILLIS

1939 to 1946:

The Carter Oil Company; Tulsa, Oklahoma.

Geologist, Exploration Geophysicist, and Research Geochemist.

FRANK DER-LIANG YOUNG
Hydrologic Engineer

Degrees: Doctor of Philosophy in Civil and Environmental Engineering – Hydraulics
Cornell University, 1976
Master of Science in Civil Engineering
California Institute of Technology, 1972
National Taiwan University, 1971
Bachelor of Science in Civil Engineer
National Taiwan University, 1968

Languages: English and Chinese

Professional Engineer – Engineer-in-Training – Illinois

Professional Societies:

American Society of Civil Engineers
International Association for Great Lakes Research

Harza Engineering Company since 1976.

Hydrology Division: Hydrologic Engineer, 1976 to date.

Experience Highlights:

Served as Project Manager and developed analytical model to simulate performance of existing cooling ponds at Black Dog powerplant, Minnesota. The model was used to develop operating rules to optimize energy generation within constraints of existing permit terms.

Developed or applied mathematical models for streamflow forecasting, dam-seepage analysis and dam-burst floodwave prediction.

Mathematically modeled thermal plume behavior of heated plant water discharged to Lake Michigan from the D. H. Mitchell Power Station in Indiana. The two-dimensional model was calibrated to measure data for three seasons, and the potential changes due to alternative heat dissipating facilities were modelled.

Hydraulic computations for potential interconnection of the north and south arms of the Great Salt Lake, Utah were made.

Available water supply was estimated and storm and flood characteristics were analyzed for the Black Bush Block III Frontlands study in Guyana S.A.

1972 to 1975:

Cornell University, Ithaca, New York.

Teaching Assistant, Research Assistant and Research Associate at the School of Civil and Environmental Engineering. Responsible for teaching and research in fluid mechanics, hydraulics and hydrology. Major research projects related to investigation of stratified lake circulation and finite element analyses of thermal pollution for large bodies of water.

FRANK DER-LIANG YOUNG

1971 to 1972:

California Institute of Technology, Pasadena, California.

Graduate Teaching Assistant in the Keck Laboratory of Water Resources and Hydrodynamics. Gave instruction in the laboratory relating to hydraulic experiments.

1969 to 1971:

National Taiwan University, Taipei, Taiwan.

Graduate student in the Department of Civil Engineering.

1968 to 1969:

Army Corps of Engineers of Republic of China.

Assistant Engineer on Ma-Tzu Isle. Participated in the design of small dams, tunnels, water resources developments, rural highway systems, and housing construction.

Technical Papers and Articles:

"Nonlinear Rarified Couette Flow of Binary Gas Mixtures," proceedings of the Chinese Society of Mechanical Engineers, No. 49, pp. 1-12., March 1972.

"Environmental Problems Associated with Fluid Flow," (with R. H. Gallagher) in Advanced Topics in the Finite Element Analysis, Newport, Rhode Island, pp. 17.524-548, August 1975.

"Finite Element Analysis of Stably-Stratified Wind-Driven Circulations," (with J. A. Liggett and R. H. Gallagher). Paper presented at Symposium on Modeling of Transport Mechanisms in Oceans and Lakes, CCIW, Burlington, Ontario, October 1975.

"Dynamics of Transient Wind-Driven Circulation in a Stably Stratified Basin by the Finite Element Analysis," Ph.D. Thesis, Cornell University, Ithaca, New York, 283 p., January 1976.

"Steady Stratified Circulation in a Cavity," (with J. A. Liggett and R. H. Gallagher), Journal of Engineering Mechanics Division, ASCE Vol. 102, No. EM1, pp. 1-17, February 1976.

"Unsteady Stratified Circulation in a Cavity," (with J. A. Liggett and R. H. Gallagher), accepted for publication in the Journal of Engineering Mechanics Division, ASCE, In press. ASCE Vol. 102 No. EM6, pp. 1009-1023, December 1976.

"Transient Finite Element Shallow Lake Circulation," (with J. A. Liggett), accepted for publication in the Journal of Hydraulics Division, ASCE, In press. ASCE Vol. 103, No. HY2, pp. 109-121, February 1977.

ROBERT A. ZYLMAN
Planning Engineer

Degree: Bachelor of Science in Civil Engineering (Honors)
Michigan State University, 1972

Professional Engineer – Illinois

Professional Societies:

American Society of Civil Engineers, Associate Member
Water Pollution Control Federation

Harza Engineering Company since 1974.

Power Resources Division Planning Engineer, 1974-75 and 1976 to date. Construction Division Resident Engineer, 1975-76.

Experience Highlights:

Assistant Project Manager for feasibility study and FERC license permit application of the 3,000-MW Brumley Gap Pumped-Storage Project in Virginia.

Acting Project Manager of a feasibility study for electric power system expansion, Honduras, including the 22.5-MW El Nispero Hydroelectric Project and the 30-MW Puerto Cortes Diesel Project.

Planning and layout engineer for various feasibility level studies on hydroelectric power projects.

Performed inspection, documentation, and field engineering on dam restoration project, Upper and Lower Dams, Occoquan, Virginia.

Participated in the prefeasibility study of the CEL System Expansion, El Salvador, including report writing, economic evaluation, and project layout of alternative 5 de Noviembre second power plant schemes.

Performed flood routing studies for Guri Stage III Development, Venezuela, and tunnel diversion studies for the Reza Shah Kabir Dam, Iran.

1972 to 1974:

City of Portage, Portage, Michigan.

Civil Engineer, Department of Public Works. Duties included all phases of municipal engineering design and construction, public business, and professional contacts.

1972:

Post-graduate studies, for three months, in water resources engineering under E.P.A. Fellowship.

ROBERT A. ZYLMAN

1972:

Eastern Mapping Company, Pittsburgh, Pennsylvania.

Survey crew chief and field representative. Duties included surveying and field control of sewage mapping project.

1971 to 1972:

Michigan State University, East Lansing, Michigan.

Part-time Engineering Assistant in the Division of Engineering Research.

PROJECT ORGANIZATION AND PERSONNEL
ORGANIZATION CHART AND RESUMES

PROJECT ORGANIZATION AND PERSONNEL

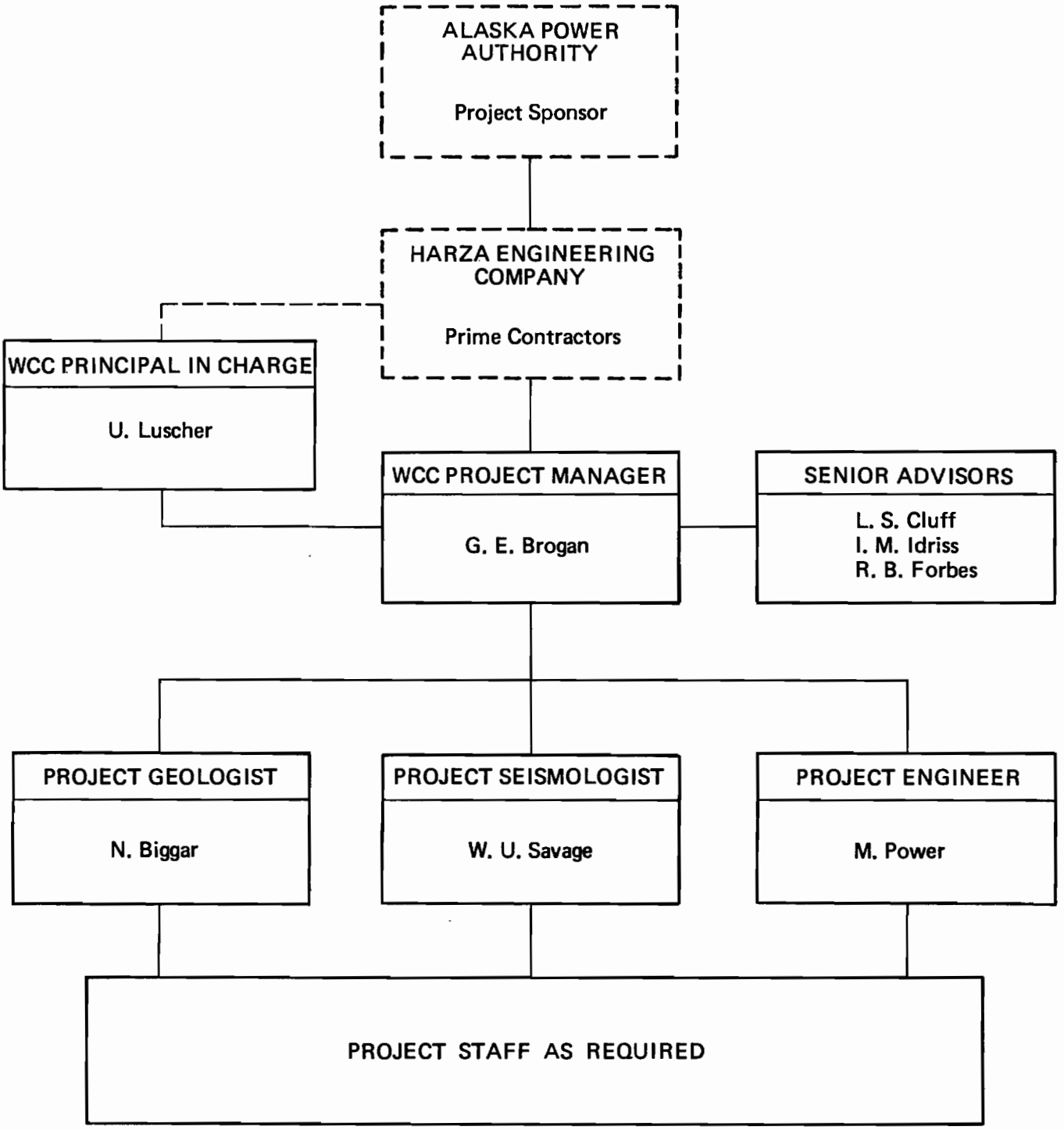
Woodward-Clyde Consultants proposes an organization for the Susitna project as shown on the figure on the next page. The resumes of all identified personnel are attached.

All project personnel are well qualified for their project functions. The Project Manager, Mr. George Brogan, has conducted several Alaska studies, including the extensive fault studies for the Alyeska oil pipeline. Over the last 12 years he has conducted and managed many projects in his specialty of seismic geology.

The subtask leaders, Ms. Norma Biggar, Dr. William Savage, and Mr. Maurice Power, are all highly qualified and they have had experience on simiar project work. They will be supported by WCC professional and sub-professional staff as needed.

Dr. Ulrich Luscher, the proposed Principal-in-Charge, has conducted many multi-disciplined projects. Among many Alaska projects on which he has worked during the last 10 years, he has headed WCC's extensive involvement in the design and construction of the Alyeska oil pipeline and is presently heading the firm's work for the Northwest Alaska gas pipeline.

Dr. L. S. Cluff is WCC's Principal-in-Charge of Geology, Seismology and Geophysics, and Dr. I. M. Idriss is the Principal-in-Charge of Earthquake Engineering. Both are internationally renowned experts in these specialties. Dr. R. Forbes has had long association with the Geophysical Institute of the University of Alaska, and is a recognized expert in Alaska geology and seismology. As Senior Advisors to the project, these individuals would provide the necessary technical direction and peer review.



ORGANIZATION CHART FOR
SEISMIC GEOLOGY, SEISMOLOGY & EARTHQUAKE ENGINEERING

George E. Brogan

engineering geology
seismic geology
structural geology
geomorphology

EDUCATION

San Diego State College: M.S., Geology, 1969
San Diego State College: B.A., Geology, 1966

REGISTRATION

Registered Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Los Angeles/Orange, California, Associate, 1978-date; Deputy Director of Geology, 1976-date; Oakland, California, Staff Geologist to Senior Project Engineering Geologist, 1971-1975
Woodward-Lundgren and Associates, Oakland, California, Consultant in Geology, 1969-1971
University of Nevada, Reno, Department of Geology-Geography, Teaching Fellow, 1968-1971
Humble Oil and Refining Co., Kingsville, Texas, Production Geologist, 1967
San Diego State College, Department of Geology, Teaching Assistant, 1966-1968
U.S. Navy Electronics Laboratory, San Diego, California, Data Analyst with San Deigo State College Foundation, 1964-1968

REPRESENTATIVE EXPERIENCE

Mr. Brogan has practiced engineering geology since 1966, and has world-wide experience in engineering geology and seismic geology on projects including nuclear and conventional power plants, dams, tunnels, pipelines, airports, high-rise buildings, offshore drilling platforms, and liquefied natural gas terminals. In connection with these numerous investigations, he has completed complex projects in diverse geographic and climatic environments. He was in charge of the evaluation of active faults for the Trans-Alaska Pipeline System, the evaluation of the Boconó fault in Venezuela for the Yacumbú tunnel, the mapping and evaluation of the Wasatch fault in Utah, the evaluation of seismic activity and faults for several power plants in Italy, studies for nuclear power plant siting in Iran, evaluations of dams and dam sites in North and South America, and mapping active faults for land-use planning in Managua, Nicaragua. He has completed studies of seismic and geologic hazards in offshore areas of California, Alaska, and the Caribbean.

His experience in siting critical facilities includes studies for domestic and foreign nuclear power plants. He managed field and office studies that identified potential nuclear power plant sites along the Southern Persian Gulf and Gulf of Oman for the Atomic Energy Organization of Iran (AEOI). After the siting studies were completed, he managed field studies of 5 of the sites; these studies were used as a basis by AEOI for selecting the favored site on the Persian Gulf. In addition to managing the Iranian siting studies, Mr. Brogan has provided high-level guidance in developing the approach and philosophy to be used in nuclear power plant siting studies in California for Pacific Gas and Electric Company (PG&E), and in Washington and Oregon for Washington Public Power Supply System (WPPSS).

Mr. Brogan has managed studies for siting other critical facilities, including siting of a proposed Liquefied Natural Gas (LNG) Import Terminal Site in California. Those studies were conducted for the California Coastal Commission, a California State agency that regulates development in coastal areas. Both onshore and offshore areas were considered, and methodologies were developed to screen coastal California for acceptable areas, and to identify positive and negative attributes of individual sites. Field studies were conducted in response to the methodologies that were developed, which resulted in ranking of 10 sites and selecting a favored onshore site and a favored offshore site.

Mr. Brogan has become a recognized leader in evaluating earthquakes and fault activity. He has convened a Geological Society of America Penrose Conference on that topic, and is an adviser to the U.S. Geological Survey Earthquake Hazard Reduction Program. He has taught graduate and undergraduate courses in geology and earthquake engineering, has lectured for many universities and professional organizations, and was selected as Woodward-Clyde Consultants' Young Professional in Geotechnical Practice in 1975. In his present position, Mr. Brogan is in responsible charge of geological, seismological, and geophysical studies within the Southern California offices of Woodward-Clyde Consultants.

AFFILIATIONS

American Association for the Advancement of Science
American Association of Petroleum Geologists
American Geological Institute
American Geophysical Union
American Society of Photogrammetry
Association of Engineering Geologists
Earthquake Engineering Research Institute
Geological Society of America
International Association of Engineering Geology
Seismological Society of America
Sigma Xi

PUBLICATIONS

Mr. Brogan has authored or co-authored more than 30 professional publications that have appeared in numerous scientific and engineering journals and proceedings of conferences and symposia. These publications include studies of the effects of recent earthquakes, case histories of studies of faulting and seismicity in many localities, and philosophical discussions regarding mitigation of geological hazards. A complete list of Mr. Brogan's publications will be provided upon request.

GEB 1-79

Ulrich Luscher

project management
geotechnical engineering
frozen soil engineering
performance and instrumentation engineering

EDUCATION

Massachusetts Institute of Technology, Cambridge: Sc.D., Civil Engineering, 1963
Massachusetts Institute of Technology, Cambridge: M.S., Structures, 1959
Swiss Federal Institute of Technology, Zurich, Switzerland: B.S., Civil Engineering, 1956

REGISTRATION

Registered Civil Engineer: California
Registered Professional Engineer: Massachusetts

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal, 1974-date; Associate and Project Engineer, 1967-1974
Massachusetts Institute of Technology, Department of Civil Engineering, Assistant Professor, Soil Mechanics, 1963-1967
Massachusetts Institute of Technology, Instructor and Research Engineer, 1959-1963
Vevey Iron Works, Switzerland, Design Engineer, 1957

REPRESENTATIVE EXPERIENCE

Dr. Luscher's professional activities over the last 22 years have covered a broad range of applied geotechnical projects with ever increasing responsibility. At present, he is in charge of a group which conducts or manages large, often interdisciplinary projects for major industrial and governmental clients. He has recently been responsible for a site evaluation for an LNG plant, a foundation investigation for a nuclear power plant, offshore site evaluations, and measurement and appraisal of building vibrations. He has also headed several recent projects related to hazardous waste storage ponds.

As the principal responsible for a field measurement group, he has overseen a number of research and development studies related to development of energy resources and including topics such as mining subsidence, mine dewatering, geothermal subsidence measurement, core recovery, and in-situ permeability measurement. He has also headed several applied field instrumentation and monitoring projects. Finally, he is responsible for the extensive WCC soil and rock mechanics laboratory in Oakland, California.

Since mid-1977, Dr. Luscher has managed several studies for the proposed chilled gas pipeline across Alaska. The work has related to trench blasting tests, a review of the existing data base for the project, seismic fault investigations, and a large laboratory test program.

Ulrich Luscher

From 1970 to 1976, Dr. Luscher was involved full-time in the Trans-Alaska oil pipeline project, leading a group of Woodward-Clyde Consultants' personnel engaged in evaluating geotechnical aspects of the pipeline system. The work included the following major areas: (1) Design of the pipeline support system, including development and application of criteria to evaluate the need for above-ground construction; (2) Development of design criteria and mile-by-mile design information for vertical support members of the above-ground pipeline; this task included field tests on prototype support members; (3) Geotechnical field engineering during construction, and development of guidelines for design changes in response to field conditions different from those assumed in the design; and (4) Preparation of surveillance and monitoring manual for use during pipeline operation.

Before 1970, Dr. Luscher acquired extensive experience in many phases of geotechnical engineering including foundations, earth retaining structures, land development, earth structures and underground conduits. He also worked on several projects involving nuclear power stations and the effects of earthquakes and other dynamic loads.

Dr. Luscher has also conducted projects involving foundation instrumentation, performance monitoring, and correlation between observed and predicted foundation performance. He has done research on the interaction of soil and underground structures and the failure conditions of foundations under static and dynamic loads.

AFFILIATIONS

American Society of Civil Engineers
International Society of Soil Mechanics and Foundation Engineering
Structural Engineers Association of Northern California

PUBLICATIONS

The following is a partial list of publications. A full list will be provided on request.

"Geotechnical Issues and Answers During Construction of the Trans-Alaska Pipeline," with H.P. Thomas, Paper No. 78-Pet-66, ASME Transaction, 1979.

"Pipe-Soil Interaction, Trans-Alaska Pipeline," with H.P. Thomas and J.A. Maple, ASCE Specialty Conference on Pipelines in Adverse Environments, New Orleans, Jan. 1979.

"Geotechnical Aspects of Trans-Alaska Pipeline," with W.T. Black and K. Nair, Proceedings, ASCE, Vol. 101, No. TE4, Nov. 1975.

"Thaw Consolidation of Alaskan Silts and Granular Soils," with S.S. Afifi, Permafrost: North American Contribution to 2nd International Conference, 1973.

Lloyd S. Cluff

seismicity and seismic geology
earthquake engineering
environmental geology
engineering geology

EDUCATION

University of Utah, Salt Lake City: B.S., Geology
University of Utah, Salt Lake City: Graduate studies in Engineering Geology

REGISTRATION

Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal, Chief Engineering Geologist, Vice President and Director, 1971-date; Associate and Chief Engineering Geologist, 1965-1971; Staff Geologist, 1960-1965
University of Nevada, Reno, Nevada, Visiting Associate Professor of Geology, 1968-1973
Lottridge Thomas & Associates, Salt Lake City, Utah, Geologist, 1960
El Paso Natural Gas Company, Salt Lake City, Utah, Junior Geologist, 1957-1959
University of Utah, Salt Lake City, Utah, Teaching Assistant, 1958-1960

REPRESENTATIVE EXPERIENCE

As Vice President and Chief Engineering Geologist, Mr. Cluff is responsible for all technical and administrative functions related to geologic, seismologic, and geophysical investigations, explorations, and evaluations. Types of projects under Mr. Cluff's direction include nuclear reactor siting studies, active fault and earthquake hazard and risk evaluations, geologic hazard evaluations, seismic safety studies, and land-use planning with regard to geologic and earthquake hazards. Mr. Cluff also directs geologic and earthquake studies relating to dams, bridges, tunnels, pipelines, highways, urban development, LNG facilities, industrial sites, oil field operations, offshore developments, groundwater development, and aggregate and quarry sites.

In March, 1978, Mr. Cluff was elected to the National Academy of Engineering. He served in 1976 and 1977 on the Newmark Panel, a panel of experts called to advise the U.S. Geological Survey, National Science Foundation, and the President regarding the national program for earthquake prediction and hazard mitigation. He serves on the Earthquake Programs Advisory Panel of the U.S. Geological Survey and is a consultant to the Office of Science and Technology Policy, Working Group on Earthquake Hazards Reduction. He is a member of the National Academy of Sciences' Committee on Seismology, and serves on their Subcommittee on seismologic and geologic considerations in the safe siting of critical facilities. He recently served on an International Strong Motion

Arrays Committee of the International Associations of Earthquake Engineering and of Seismology and Physics of the Earth's Interior. He has served as consultant to the U.S. Atomic Energy Commission, Oak Ridge National Laboratory, regarding active faulting and earthquake effects on nuclear reactor safety.

As a member of the State of California's Task Committee on Seismic Hazards from State-Owned/Occupied Structures, Mr. Cluff is involved in the definition of standards for the evaluation of seismic risk. He was a member of the Stanford Research Institute Oversight Committee on Earthquake Prediction, and the State of California Energy Resources Conservation and Development Commission Advisory Panel on earthquake and geologic hazards in California.

Mr. Cluff has made more than 15 post-earthquake evaluations of the geologic effects of damaging earthquakes throughout the world as a post-earthquake evaluation team member for the Earthquake Engineering Research Institute, the International Association of Engineering Geologists, the California Seismic Safety Commission, and the California Governor's Earthquake Council.

Since 1967, Mr. Cluff has served as consultant to the Venezuelan Presidential Earthquake Commission. From 1966 to 1970, he served as consultant to the State of Utah Governor's Earthquake Council and to the Utah Geological and Mineralogical Survey regarding active faulting, earthquake, and geologic hazards in Utah.

From 1968 to 1973, he served as a member of the Consulting Board of the San Francisco Bay Conservation and Development Commission, Earthquake Engineering Criteria Review Board. In 1969, he served as a member of the Special Panel of Consultants to the President and the Secretary of the Interior for the Santa Barbara oil spill, and was responsible for reviewing earthquake problems in that area.

As a member of the International Consulting Board for the International Atomic Energy Agency in Vienna, Mr. Cluff advised on geologic, seismologic, and earthquake engineering problems associated with siting nuclear power reactors in foreign countries. He has served as a consultant to the atomic energy commissions of the governments of Mexico, Chile, Italy, and Iran, regarding active faulting, earthquakes, and geologic hazards with respect to siting nuclear reactors. Since 1970, he has served as consultant to Ente Nazionale Per L'Energia Elettrica, Milan, Italy, on geologic and earthquake hazards with respect to siting fossil fuel power plants in Italy. He has also served as consultant to Ente Nazionale Per L'Energia Elettrica, Rome, Italy, regarding active faulting and earthquake problems in siting nuclear reactor power plants in Italy. He has served as consultant to Comision Federal de Electricidad, Mexico, regarding dam safety from active faulting and earthquakes.

He served as a member of the State of California Joint Committee on Seismic Safety, Advisory Group on Land Use Planning to Minimize Earthquake Risk. Since 1970, Mr. Cluff has served as a member of the UNESCO Consulting Board in Paris for "seismic phenomena associated with the filling of large reservoirs." He has served as consultant to the U.S. Corps of Engineers, Vicksburg research facility, and the U.S. Bureau of Reclamation regarding active faulting and earthquake effects on dams.

Mr. Cluff is a member of the Board of Directors of the Earthquake Engineering Research Institute. He was President of the Association of Engineering Geologists, 1968-1969. He also served as Vice President of the International Association of Engineering Geologists, 1970-1974. He is Chairman of the International Association of Engineering Geology Commission, studying worldwide seismic phenomena.

Mr. Cluff is listed in Engineers of Distinction (1970) and American Men of Science (1975).

AFFILIATIONS

National Academy of Engineering
Association of Engineering Geologists
Earthquake Engineering Research Institute
Geological Society of America
International Association of Engineering Geologists
Seismological Society of America
Structural Engineers Association of Northern California
Utah Geological Association

PUBLICATIONS

Mr. Cluff has authored and co-authored more than 50 technical papers on subjects relating to geology, seismology, and engineering. These papers have been published in national and international journals, and proceedings of conferences and international meetings.

LSC 8-78

I.M. Idriss

earthquake engineering
soil mechanics and foundation engineering
numerical techniques and computer applications

EDUCATION

University of California, Berkeley: Ph.D. Civil Engineering, 1966
California Institute of Technology: M.S. Civil Engineering, 1959
Rensselaer Polytechnic Institute: B.C.E., Civil Engineering, 1958

REGISTRATION

Civil Engineer: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal and Vice President, 1974-date
Woodward-Clyde Consultants, San Francisco, California, Director, 1975-date
Stanford University, Department of Civil Engineering, Consulting Professor, 1977-date
Woodward-Clyde Consultants, Oakland, California, Associate, 1969-1974
University of California, Berkeley, Department of Civil Engineering, Associate Research Engineer, 1966-1975
Consultant to several architect-engineers and other firms, 1966-1969
Dames & Moore, San Francisco, California, Senior Soils Engineer, 1968-1969
University of California, Berkeley, Department of Civil Engineering, Lecturer in Soil Mechanics, 1967-1968
Dames & Moore, Los Angeles, New York and San Francisco, Field Engineer to Project Manager, 1959-1966
Moran, Proctor, Meuser & Rutledge, Field Engineer, New York, New York, Summer, 1958

REPRESENTATIVE EXPERIENCE

Dr. Idriss has been engaged in the practice of soil mechanics and foundation engineering since 1958 and has worked on foundation investigations for land developments, industrial buildings, power plants, earth dams, offshore structures and other facilities. Since 1964, he has also been engaged in research and applications pertaining to: the seismic response of soil masses and soil structures; evaluation of the failure potential of soils; soil material properties during cyclic loading; soil-structure interaction during earthquakes; and characteristics of ground motions. As a result of this research, he has developed and co-developed several analytical and empirical procedures for the evaluation of the behavior of soil masses during earthquakes. Recent consulting assignments have included seismic investigations for earth and rockfill dams, sites for nuclear power plants, high-rise buildings, offshore platforms, and industrial facilities, and applied research studies.

I.M. Idriss

Dr. Idriss is director of geotechnical earthquake engineering studies for the Western Region of Woodward-Clyde Consultants. He has conducted and directed such studies for over 25 earth and rockfill dams in California, Alabama, North Carolina, Tennessee, and in Latin America. He has also conducted and directed earthquake engineering studies (including ground-motion characterization, assessment of liquefaction potential, evaluation of soil-structure interaction, cyclic soil characterization) at over 20 nuclear plant sites in the USA, Europe and the Middle East. Other projects for which he has conducted and directed geotechnical earthquake engineering studies include offshore platforms in California, Alaska, and New Zealand, and waterfront facilities, fossil plants, land developments in California, Idaho, Alaska, New Jersey, Texas, Italy, Puerto Rico, Iran, Nicaragua, Venezuela and other locations. Among the more recent applied research and non-site specific studies he has been engaged in are the following:

Soil-structure interaction studies for GESSAR and for General Electric's Standard Plant (1973-date); assessment of behavior of marine clay sediments during earthquake loading conditions (1973-date); assessment of behavior of marine clay sediments during wave loading conditions (1976-date); behavior of soil-pile-structure systems during earthquakes (1976-date); soil-structure interaction studies and correlations with model field tests (1976-1978); probabilistic and deterministic assessment of ground motions in Southern California for small and moderate earthquakes (1976-date); and Offshore Alaska Seismic Exposure studies (1977-date).

Recent Applied Research Activities: Since early 1975, Dr. Idriss has been conducting research related to the nonlinear behavior of soils under cyclic loading conditions. The results of this research have been applied to assessing performance of soft sediments during earthquakes. Other research activities in which Dr. Idriss has been engaged relate to: significant duration of earthquakes, simplified procedures for assessment of seismic soil-structure interaction, and probabilistic review and assessment of recorded ground motions and associated spectra.

HONORS

Norman Medal, ASCE, 1977
Walter L. Huber Civil Engineering Research Prize, ASCE, 1975
Woodward Lecture, Woodward-Clyde Consultants, 1973
J. James Croes Medal, ASCE, 1972
The Thomas A. Middlebrooks Award, ASCE, 1971
Chi Epsilon (Honorary Member, Rensselaer Polytechnic Institute Chapter)
Tau Beta Pi
Sigma Xi

IMI 3-79

SPECIAL ASSIGNMENTS

1966-date: invited lecturer at various universities in the United States, Latin America, Canada, Europe, and the Middle East
1971-date: invited lecturer at specialty conferences and special courses in the United States, Latin America, and Europe
1975-date: consultant to the International Atomic Energy Agency, Vienna; participated in preparation of IAEA's Safety Guide on "Seismic Analysis and Testing of Nuclear Power Plants"
1970-1976: consultant to the Government of Italy on nuclear reactor safety related to earthquake effects
1974-1977: Member, Subcommittee on Ground Motions and Site Effects, Applied Technology Council

AFFILIATIONS

American Society of Civil Engineers
Member: Publications Committee, Geotechnical Division; Nuclear Structures and Materials Committee, Structural Division (Chairman, Ad Hoc Group on Soil-Structure Interaction)
Earthquake Engineering Research Institute
Seismological Society of America
Structural Engineers Association of Northern California
Member: Seismology Committee (Soil-Structure Interaction Subcommittee; Chairman 1971-1972; 1977-1979)
U. S. Committee of the International Commission on Large Dams
American Petroleum Institute

PUBLICATIONS

Dr. Idriss has authored or co-authored over 60 technical papers and research reports on subjects relating to the geotechnical aspects of earthquake engineering (seismic response of soil deposits; earth structures including slopes and earth and rockfill dams; dynamic soil material properties; liquefaction; soil-structure interaction; and probabilistic and deterministic assessment of characteristics of ground motions.) These papers have been published in the Journals of the Geotechnical Engineering Division, the Structural Engineering Division and Proceedings of Specialty Conferences of the American Society of Civil Engineers; Bulletin of the Seismological Society of America; International Journal of Earthquake Engineering and Structural Dynamics; Proceedings of World Conferences on earthquake engineering, Offshore Technology Conference, and proceedings of other international engineering meetings.

Robert B. Forbes

senior project advisor
consultant

EDUCATION

University of Washington: Ph.D., Geology, 1959
University of Washington: B.S., Geology, 1948

PROFESSIONAL HISTORY

Senior Geologic Consultant, Geophysical Institute, University of Alaska, 1976-present
Professor of Geology, Geophysical Institute and Geology Department, University of Alaska, 1970-1976
Visiting Research Geologist, Alaskan Geology Branch, USGS, Menlo Park, California, 1969-1970. (Temporary appointment; Sabbatical Leave academic year 1969-70)
Professor and Head, Geology Department, University of Alaska Geology Dept. and Geophysical Institute, 1965-1969
Associate Professor of Geology, Geophysical Institute and Geology Department, University of Alaska, 1964-1965
Visiting Research Professor in Petrology, Geophysical Institute University of Tokyo, Tokyo, Japan (NSF Science Faculty Fellowship), 1963-1964
Associate Professor of Geology, Geophysical Institute and Geology Dept., University of Alaska, 1961-1963
Assistant Professor, Geology Department, University of Alaska, 1959-1961
Research Associate, Department of Geology, University of Washington, 1957-1959
Assistant and Acting Chief, Research Branch, Office of Research Development, OQMG, Washington, D.C., 1955-1957
Department of Army Expeditions Project Supervisor, 1953-1955
Chief, Field Observation Branch, OQMG, Department of Army, Washington, D.C., 1952-1953
Consultant, Mountain Environment Project, Department of Army, Washington, D.C., 1951-1953
Geologist and Executive Officer, Juneau Ice Field Research Project, (spring-summer) 1949-1950

HONORS

Vice President, Section of Volcanology, Geochemistry and Petrology, American Geophysical Union, 1970-1972
National Science Foundation Science Faculty Fellow in Geology (Geological Institute, Tokyo University), 1963-1964
Department of Army Outstanding Performance Award (Special award for Antarctic research), Jan., 1957

Robert B. Forbes

PROFESSIONAL ORGANIZATIONS

Fellow, Geological Society of America
Fellow, Arctic Institute of North America
Fellow, American Association for the Advancement of Science
Member, American Geophysical Union
Member, American Association of Petroleum Geologists
Member, Signma Xi
Member, American Polar Society

PRESENT RESEARCH INTERESTS

Petrology and geochemistry of igneous and metamorphic rocks, with current emphasis on andesitic volcanism and the petrology of blueschist and eclogite facies metamorphic rocks; volcanology, including geophysical and geochemical studies of Alaskan volcanoes; exploration and utilization of Alaskan geothermal and uranium resources.

PUBLICATIONS

Dr. Forbes has published or presented over 95 papers and reports. A complete list of these can be submitted on request.

Norma E. Biggar

geology

EDUCATION

University of Alaska, Fairbanks: M.S., Geology, 1974
Antioch College, Yellow Springs, Ohio: B.A., Geology, 1970

REGISTRATION

Registered Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Staff Geologist to Project Geologist, 1973-date
Geophysical Institute, University of Alaska, Research Assistant, 1971-1973
Wright State University, Teaching Assistant, Department of Geology, 1971
Dr. Ronald G. Schmidt, Consulting Geologist, Yellow Springs, Ohio, Draftsperson, 1971

REPRESENTATIVE EXPERIENCE

Ms. Biggar has served as the project geologist for the active fault identification study for the proposed Alcan gas pipeline in Alaska; and for the geological and seismological investigations of the New Melones Dam site in California.

She served as technical editor for the Woodward-Clyde Consultants' book, "Age Dating of Geologic Materials", in addition to researching and compiling many of the age-dating discussions presented in the book, and is presently preparing a manuscript of the book for publication. Since joining Woodward-Clyde, she has also been involved in regional geologic studies for the siting of a proposed LNG plant at Yakutat, Alaska, nuclear reactors in the Persian Gulf of Iran, Italy, and the Central Valley of California, and the detection of active faults for the Trans-Alaska pipeline project.

An overall geologic study of the Chena Hot Springs area near Fairbanks, Alaska was the topic of Ms. Biggar's Master's Thesis. This investigation included a 35-square mile mapping project of the granitic and metamorphic units in the vicinity of the thermal springs, and geochemical, geophysical and ground temperature studies in the thermal area.

AFFILIATIONS

Geological Society of America
Association of Women Geoscientists
Association of Engineering Geologists

NEB 6-78

Norma E. Biggar

PUBLICATIONS

"Alaska's geothermal resource potential", with R. B. Forbes, The Northern Engineer, V. 5, No. 1, 1973.

"Identification of distinguishing characteristics of late Quaternary faults in the Western Sierran foothills, California", with R. F. Harpster and C. L. Taylor, Abstracts, Earthquake Notes, V. 49, no. 1, pp. 88-89, 1978.

"Evaluation of Quaternary faulting in colluvium and buried paleosols, Western Sierran Foothills, California", with W. D. Page, F. H. Swan III, R. Harpster and L. S. Cluff, Abstracts with Programs, Cordilleran Section, Geological Society of America, V. 10, no. 3, p. 141, 1978.

NEB 6-78

William U. Savage

seismology
geophysics
seismic geology

EDUCATION

University of Nevada, Reno: Ph.D., Seismology, 1976
University of Nevada, Reno: M.S., Seismology, 1971
University of Washington: National Science Foundation Graduate Fellow, Geophysics, 1966-1968
University of Oregon: B.S., Physics, 1966

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Senior Project Seismologist, 1974-date
United States Geological Survey, Menlo Park, California, Research Associate, 1973-1974
University of Nevada, Reno, Seismological Research Assistant, 1969-1973

REPRESENTATIVE EXPERIENCE

Dr. Savage has applied his seismological research experience and training to a large number of projects at Woodward-Clyde Consultants. He has conducted historical seismicity evaluations, seismotectonic interpretations, and seismic safety analyses for high-rise buildings, thermal and nuclear power plant sites, offshore oil developments, and other critical engineering projects, both in the United States and overseas. Dr. Savage has recently completed several major investigations of microearthquake occurrence as related to the development of seismic design criteria for major projects. These projects, in the United States, the Middle East, and Latin America, involved the design and installation of both portable and permanent telemetered arrays of field microearthquake recorders, the analysis of the resulting data, and the interpretation of the results leading to seismic safety and design information. These studies have been significant in understanding earthquake hazards in complex geologic environments. Dr. Savage is leading the Woodward-Clyde Consultants program in developing additional capabilities in microearthquake instrumentation and applications.

During the past several years, Dr. Savage has participated as a key member representing the fields of seismology on several interdisciplinary project teams. These projects have involved siting studies and safety analyses for the major dams of Auburn, California, the Coca River, Ecuador, and the Chulac and Xalala projects, Guatemala, and for the nuclear power plants at Hanford, Washington, Humboldt Bay, California, and San Onofre, California, and proposed plants at Stanislaus, California, and in Southern Iran. Dr. Savage has directed field studies and data analyses for seismological aspects of the projects and has worked with other technical experts in the earth sciences and engineering to synthesize and integrate the results of the investigations performed and to mutually develop and apply the methodologies leading to specific engineering results.

William U. Savage

Dr. Savage has recently completed a study of the seismicity of the Alaskan Interior for the proposed Alcan gas pipeline. In this study, detailed analyses of the microearthquake data along and east of the Denali fault were carried out to assess the location, level of activity, and sense of movement of potentially active faults.

While with the U.S. Geological Survey's National Center for Earthquake Research as a Postdoctoral Research Fellow, Dr. Savage participated in studies of historical seismicity, microearthquake seismicity, and seismic velocities pertinent to earthquake prediction. At the University of Nevada, Dr. Savage helped supervise the installation of a statewide telemetered seismic network and studied the statistical occurrence features of earthquake activity.

AFFILIATIONS

American Association for the Advancement of Science
American Geophysical Union
Seismological Society of America
Geological Society of America
Earthquake Engineering Research Institute

PUBLICATIONS

Dr. Savage has authored numerous reports and portions of reports ranging from brief summaries of site-related observations to lengthy presentations of the technical results of major studies and to regulatory agency documentation such as Preliminary Safety Analysis Reports for the U.S. Nuclear Regulatory Commission. In addition, much of his work has received peer review within the academic and professional community through presentations at scientific meetings and the publication of technical articles in professional journals. A complete list of publications is available upon request. Dr. Savage has also presented technical seminars and public lectures both locally and abroad on topics related to earthquake hazards, current seismological research, and engineering seismology.

WUS 6-79

Maurice S. Power

soil mechanics
foundation engineering
earthquake engineering

EDUCATION

University of California, Berkeley: M.S., Soil Mechanics, 1962
Stanford University, Stanford: B.S., Civil Engineering, 1961

REGISTRATION

Civil Engineer: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Staff Engineer to Associate, 1966-date
Naval Air Station, Grosse Ile, Michigan, Assistant Public Works Officer, 1963-1965
Harding, Lawson & Associates, San Rafael, California, Field and Laboratory Engineer and Staff Engineer, summers 1960-1962

REPRESENTATIVE EXPERIENCE

Mr. Power has been engaged in analysis, design, planning and project management for a wide range of foundation engineering and earthquake engineering studies. Since 1970, he has worked primarily in earthquake engineering applications, including liquefaction potential evaluations, characterization of soil dynamic properties, ground response analyses, earthquake ground motion studies, soil-structure interaction analyses, and seismic stability evaluations of slopes and dams.

Representative projects include:

Earth and Rockfill Dams: Upper San Leandro Dam (San Leandro, California); San Pablo Dam (San Pablo, California); Chabot Dam (near Oakland, California); five proposed earth and rockfill dams (near Raleigh, North Carolina); two proposed earth dams (near Columbia, South Carolina); two proposed earth dams (near Walnut Creek, California); and Watauga Dam (Tennessee).

Nuclear Plant Sites: Summer Plant (near Columbia, South Carolina); Shearon Harris Plant (North Carolina); South Texas Project (near Bay City, Texas); X21-X22 Nuclear Station (northeastern Tennessee); X24-X25 Nuclear Station (Tishomingo County, Mississippi); proposed Stanislaus Plant (central California); Humboldt Bay Plant (Humboldt Bay, California); San Onofre Nuclear Generating Station (Southern California).

Industrial Facilities and Building Sites: Projects include foundations and seismic investigations for many types of facilities including: assessment of liquefaction potential and design response spectra for offshore platforms Maui A and Maui B in New Zealand; foundation and seismic studies for the Port of Oakland, California Middle Harbor Terminal (wharves, dikes and fills), preliminary characterization of ground motions

and evaluations of liquefaction potential for a proposed LNG facility in Yakutat, Alaska; soil and foundation studies for the Trans Alaska Pipeline; earthquake ground motion studies for proposed offshore oil platforms in the Santa Barbara Channel, California; preliminary evaluations of geotechnical conditions and geologic hazards for offshore platforms on the Kodiak outer continental shelf, Alaska; geotechnical planning and feasibility study for offshore guyed tower platforms; applied research on the behavior of offshore soil-pile-structure systems during earthquakes.

Other representative projects include: characterization of earthquake ground motions and ground motion probability studies for the proposed Auburn Dam, California; evaluation of the causes of damage to the Joseph Jensen Water Filtration Plant (Los Angeles, California) during the 1971 San Fernando earthquake; preparation of input for the seismic safety element, City of Fremont, California; foundation studies and seismic evaluations for the Loma Linda Veterans Administration Hospital (Loma Linda, California); evaluation of liquefaction potential of gravels beneath sand and gravel pits proposed to be used for solid waste disposal (Pleasanton, California); evaluations of expansive soil effects on residential housing in California, Colorado, Texas and Alabama for the Federal Housing Administration; earthquake engineering and wave loading studies for the proposed Southwest Ocean Outfall, offshore San Francisco, California; seismic soil-structure interaction studies for General Electric's Standard Nuclear Plant.

AFFILIATIONS

American Society of Civil Engineers
Earthquake Engineering Research Institute
Seismological Society of America

PUBLICATIONS

"A Simplified Procedure for Developing Interaction Response Due to Variations in Soil Properties," paper presented at the ASCE Structural Division Specialty Conference on Methods of Structural Analysis, Madison, Wisconsin, with K. Sadigh, C-Y. Chang, and T. Udaka, August 1976.

"Soil Response Considerations in Seismic Design of Offshore Platforms," Journal of Petroleum Technology, with I.M. Idriss and R. Dobry, March 1976.

"A Study of Attentuation of Ground Motion Parameters for Moduate Magnitude Earthquakes," Sixth European Conference on Earthquake Engineering, Dubrovnik, Yugoslavia, with K. Sadigh and R.R. Youngs, September 1978.

"Peak Horizontal and Vertical Accelerations, Velocities, and Displacements on Deep Soil Sites for Moderately Strong Earthquakes," Proceedings, Second International Conference on Microzonation, San Francisco, California, with K. Sadigh and R.R. Youngs, November 1978.

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RELEVANT EXPERIENCE AND QUALIFICATIONS

RELEVANT EXPERIENCE

General

Woodward-Clyde Consultants is a nationwide consulting firm practicing in the general fields of geotechnical engineering and environmental assessment. We offer such services as earthquake engineering, site selection, engineering, geology, seismology, environmental impact assessment, and decision analysis.

We have a staff of about 800 professional and support personnel, three-quarters of whom are graduate engineers and scientists or skilled technicians. Approximately 350 hold advanced degrees in the physical sciences (chemistry, geology, geophysics, hydrology, meteorology, physics, and physical oceanography), engineering (civil, geotechnical, mechanical, nuclear, chemical, and sanitary), the natural sciences (terrestrial and aquatic ecology and biological oceanography), and the social sciences (economics, land-use/urban planning, sociology).

WCC has conducted studies for a large number of projects to evaluate the characteristics of site ground motions during earthquakes and the potential for seismically-induced failure of in-situ soil deposits and earth and rockfill dams. Several of these projects are in Alaska. The attached table summarizes the earth and rockfill dams for which seismic stability evaluations have been made by WCC. Our scope of work for several of these dams is described in the project summaries following this section. The studies have ranged from regional to site-specific evaluations, and from feasibility to final design studies. The Offshore Alaska Seismic Exposure Study (OASES), which is summarized in the attachments, is particularly relevant to and useful for the probabilistic assessments of earthquake ground motions that will be made for the Susitna project.

QUALIFICATIONS AND EXPERIENCE/GEOLOGY-SEISMOLOGY-GEOPHYSICS

Woodward-Clyde consultants maintains a talented, multidisciplinary group of earth scientists engaged in geological, seismological, and geophysical investigations. The Director of the Geology-Seismology-Geophysics Professional Group is Lloyd S. Cluff, an internationally recognized expert in engineering geology and seismic geology. Until recently, the Chief Seismologist with Woodward-Clyde Consultants has been the late Dr. Don Tocher, a recognized authority in the fields of seismology and engineering seismology. The Geology-Seismology-Geophysics Group is composed of more than 125 professionals and is based in San Francisco, California. This group provides Woodward-Clyde Consultants with unmatched depth of experience and diverse capabilities in the earth science.

The Geology-Seismology-Geophysics Professional Group brings to the Susitna project, many hundreds of person-years involved with studies of regional seismicity, active faulting, and seismic hazard evaluation for major engineering projects. These past and present studies are world-wide in distribution and include extensive experience in Alaska. The fault study completed by Woodward-Clyde Consultants for Alyeska Pipeline Service Company in 1974 was a landmark investigation that established design parameters for active fault crossings and improved the knowledge of earthquake sources for the region of the Alyeska pipeline route. The area examined in detail in the study for Alyeska borders the study area for the proposed Susitna project. The Alyeska study demonstrated that the Woodward-Clyde Consultants project team has the capability to deliver the necessary and appropriate results of complex investigation carried out in Alaskan field conditions.

In addition, we have performed regional fault and seismicity studies for Alaska Outer Continental Shelf sites; the proposed NWAP gas pipeline in Alaska; regional and local fault, seismicity, and geophysical studies for marine terminal facilities proposed for Yakutat, Alaska; numerous seismicity and fault evaluations for nuclear power plant sites in California, Washington, Arizona, New Mexico, Texas, New York, Nicaragua, and Iran; regional seismicity and fault studies for numerous large dams; and fault mapping and earthquake recurrence evaluations in Alaska, California, Nevada, Arizona, Utah, Idaho, Washington, Italy, Venezuela, Argentina, Iran, Nicaragua, Guatemala, Colombia, and Ecuador. The experience gained in these investigations has resulted in the development of methodologies to effectively acquire, analyze, evaluate, document, and defend varied data analyses and interpretations for major engineering projects under close scrutiny of regulatory agencies. The attached descriptions illustrate the experience and services we have provided in some of our past projects.

QUALIFICATIONS AND EXPERIENCE - EARTHQUAKE ENGINEERING

In its Western Region, WCC has a permanent group engaged in earthquake engineering studies. The director of the Earthquake Engineering Group is Dr. I. M. Idriss, who is an internationally-known expert in this field. A staff of 13 engineers currently comprises the Earthquake Engineering Group in the San Francisco office of WCC's Western Region. An additional 3 engineers in the Earthquake Engineering Group are located in our Orange, California office. This group of engineers provides a depth of experience and capabilities for a variety of earthquake engineering applications.

The types of services engaged in by the Earthquake Engineering Group include: a) characterization of earthquake ground motions for design purposes; b) characterization of soil dynamic properties and cyclic strength characteristics; c) nonlinear analyses of the response of soil deposits to earthquakes, including development of improved procedures for analyses and material characterization; d) evaluations of the potential for seismically induced ground failures, including liquefaction and slope instability and ground deformations, and development of remedial measures; e) dynamic analyses of soil-structure interaction.

For use in characterizing ground motions and conducting dynamic response analyses, WCC has a data bank on computer files of recorded earthquake ground motions. The motions on file include all those digitized and processed at the California Institute of Technology and many other records from Alaska, Japan, South America and other locations acquired, digitized and processed by WCC.

For support in the evaluation of soil dynamic properties and cyclic strength, WCC has one of the finest soil laboratories in the country in Oakland, California. The laboratory has extensive experience in dynamic testing of soils. In addition, the laboratory has conducted extensive testing of frozen soils, mostly for the Alyeska pipeline project. Field support services for evaluation of soil dynamic properties include a strong geophysics capability, including proven equipment and techniques developed by WCC for the in situ measurements of shear wave velocity.

The types of earthquake engineering services summarized above have been applied to a variety of construction pro-

jects, including dams, nuclear power plants, offshore oil and gas platforms, port developments, bridges, LNG facilities, pipelines, and many other industrial and commercial projects.

RESUMES

Following is a list of proposed personnel for the study on alternative power sources in the Railbelt area of Alaska. A detailed resume for each is contained in this section:

John S. Coons	Senior Mechanical Engineer
Shinn Inouye	Manager, Structural Division
Sidney Mayster	Manager, Generating Plant Systems
Achyut V. Setlur	Supervising Structural Engineer
John Truitt	Supervising Electrical Engineer

FLUOR

JOHN S. COONS

Resumé

SENIOR MECHANICAL ENGINEER

DATE AND PLACE OF BIRTH:

June 30, 1947, Evanston, Illinois

EDUCATION:

B.S. in Mechanical Engineering
Clemson University, 1968

M.S. in Mechanical Engineering
Northwestern University, 1978

SUMMARY OF EXPERIENCE:

Lead engineer in Power Technology Division, responsible for technical direction and daily administrative duties. In charge of fluid flow analysis; turbine-generator cycle analysis and optimization, cooling system cycle analysis and optimization; and relief valve and discharge piping fluid analysis. Supervises the preparation of design studies and evaluation reports for major power plant systems and components. Responsible for application and results of computer programs dealing with analysis of mechanical components.

Developing equations for a computer program which would enable a plant operator to evaluate plant performance and to make comparisons with past performance, correcting for weather conditions, makeup, etc.

Plant heat cycle analysis and evaluation, performance analysis and optimization of major plant systems, and systems transient performance analysis.

Responsible for integration of steam turbine-generator cycle analysis with the cooling cycle analysis leading to lower plant cost. Responsible for evaluation of industrial heat cycles (cogeneration) used to produce electrical power and process steam. Includes consideration and evaluation of various alternatives in terms of capital cost, operating cost, and operational flexibility.

Responsible for the development, maintenance, and application of a generalized analytical computer model for thermal analysis of fossil and nuclear steam turbine-generator cycles.

RESUME: JOHN S. COONS

Involved in conceptual design of a computer program for evaluation of cooling systems for Florida Power Corporation. Responsible for development and computerization of analytical methods to calculate steam turbine-generator cooling system performance and deaerator boiler feed pump transients.

Conducted analytical research for the development of a gas turbine waste heat recovery boiler computer program for both industrial and aircraft type gas turbines as well as fired or unfired waste heat recovery boilers.

Conducted engineering evaluation studies for the selection of steam turbine-generators, analysis of safety relief valve systems, feedwater heater control valves, and steam turbine cooling systems. Provided expertise on modifications to proposed and existing steam turbine cycles.

TECHNICAL SOCIETY:

American Society of Mechanical Engineers

REGISTRATION:

Professional Engineer: Illinois No. 62-35628, 1977

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (1971 to Present)

PROJECT ENGINEER

Trimble County Unit 1 550 MW Coal-Fired	Louisville Gas & Electric Co. Trimble County, Kentucky
Madison Power Plant	Oscar Mayer & Company Madison, Wisconsin

ANALYTICAL ENGINEER

Dresden Power Station Study of Plant Operation During Repair	Commonwealth Edison Co. Morris, Illinois
Mill Creek 4 495 MW Coal-Fired Plant	Louisville Gas & Electric Co.
Mill Creek 3 495 MW Coal-Fired Plant	Louisville Gas & Electric Co.
Growth Project for Computerization of Steam Turbine Generators	Fluor Power Services, Inc. Chicago, Illinois

RESUME: JOHN S. COONS

PRATT & WHITNEY AIRCRAFT, EAST HARTFORD, CONNECTICUT (1969 to 1971)

ANALYTICAL ENGINEER

Member of a team which developed a modular computer program for the simulation of gas turbine cycles. Responsible for producing a computer program to interpolate data points of compressor and turbine maps. Responsible for optimization of gas turbine engines, used in a publication to airframe manufacturers.

FLUOR

SHINN INOUYE

Resumé

MANAGER, STRUCTURAL DIVISION

DATE AND PLACE OF BIRTH:

December 8, 1930, Centerville, California

EDUCATION:

B.S. in Architectural Engineering
University of Illinois, Urbana, Illinois, 1953

SUMMARY OF EXPERIENCE:

In his more than twenty years with the company, Inouye has served in a variety of capacities, beginning as a design engineer and culminating with his assignment as manager of the structural division. In this position, he administers all structural engineering and design, architectural, civil/hydraulic and structural analytical work contracted by the company. He approves manpower and cost estimates, assigns key personnel to projects, and supervises all structural division activities.

As project structural engineer on the Kewaunee Nuclear Power Plant project, he was responsible for structural, civil/hydraulic, and architectural engineering and design, specifications and procurement of materials, construction and quality assurance and control interface. The project used innovative engineering and construction techniques such as the multibarrier containment concept, building block design that resulted in time and cost savings by the elimination of piles due to greatly reduced differential settlements, and a leak tight spent fuel storage pool.

Previous assignments involved structural design work for a number of facilities including fossil-fueled generating plants from 44 to 550 MW, gas turbine units, and substations.

LANGUAGES:	SPEAK
Japanese	Moderately Well

PROFESSIONAL SOCIETIES:

American Society of Civil Engineers
American Concrete Institute
American Society of Testing Materials

RESUME: SHINN INOUYE

REGISTRATIONS:

Structural Engineer: Illinois No. 81-3121, 1967
Professional Engineer: Wisconsin No. E10731, 1968

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (1956 to Present)

MANAGER, STRUCTURAL DIVISION

PROJECT MANAGER

Calloway Nuclear Power Plant Units 1 & 2 Cooling Water Pipe and Water Management Plan Review	Union Electric Co. St. Louis, Missouri

PROJECT STRUCTURAL ENGINEER

Kewaunee Nuclear Power Plant Unit 1 (550 MW) & 345 kV Substation	Wisconsin Public Service Corp. Green Bay, Wisconsin
Weston Substation 345/115 kV	Wisconsin Public Service Corp. Green Bay, Wisconsin
Waukegan Generating Station Gas Turbine Installation	Commonwealth Edison Co. Waukegan, Illinois
Terminal Substation 345/115 kV	Northern States Power Co. Minneapolis, Minnesota
Parkers Lake Substation	Northern States Power Co. Minneapolis, Minnesota
Sycamore Gas Turbine and Associated Substation	Madison Gas & Electric Co. Madison, Wisconsin
Fitchburg, Nine Spring, and Pheasant Branch Substations	Madison Gas & Electric Co. Madison, Wisconsin

ASSISTANT PROJECT ENGINEER

Allen S. King Generating Station Unit 1, 574 MW Coal-Fired and 345 kV Substation	Northern States Power Co. Bayport, Minnesota

RESUME: SHINN INOUYE

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (CONT)

ASSISTANT STRUCTURAL ENGINEER

Pulliam Generating Station Unit 8, 125 MW Coal-Fired	Wisconsin Public Service Corp. Green Bay, Wisconsin
Cane Run Generating Station Unit 6, 250 MW Coal-Fired and Associated Substations	Louisville Gas & Electric Co. Louisville, Kentucky

GROUP LEADER

Blount Street Generating Station Unit 7, 50 MW Fossil-Fired and Associated Substations	Madison Gas & Electric Co. Madison, Wisconsin
South Bay Generating Station Two 140 MW Units Oil-Fired and Associated Substations	San Diego Gas & Electric Co. San Diego, California
Highway "V" Substation	Wisconsin Public Service Corp. Green Bay, Wisconsin

DESIGN ENGINEER

Pulliam Generating Station Unit 7, 75 MW Coal-Fired and Associated Substation	Wisconsin Public Service Corp. Green Bay, Wisconsin

CORN PRODUCTS REFINING COMPANY, CHICAGO, ILLINOIS (1955 - 1956)

DESIGN ENGINEER

Analyzed existing and designed new structural systems for supporting process equipment and tanks.

FLUOR

ROBERT W. LARSON *Resumé*

SUPERVISOR - PRELIMINARY PLANNING SECTION

DATE AND PLACE OF BIRTH:

September 8, 1922, Galesburg, Illinois

EDUCATION:

Courses in Physics and Mathematics
Central YMCA College

SUMMARY OF EXPERIENCE:

Serves as the Supervisor, Preliminary Planning Section, with responsibility for preliminary design and layout necessary to initiate power plant projects.

As Planning Section Group Leader, performed the design and layout of several fossil-fired power plants ranging in size from 50 MW to 500 MW, and a 530 MW nuclear power plant. Duties included preparation of site layout; general arrangement, piping and ventilation system drawings; coordination and review of mechanical and electrical equipment and piping, plumbing, and ventilation systems; and liaison with equipment manufacturers in regard to turbine, steam generator, pump, heat exchangers, tanks, and other heavy equipment drawings.

Industrial experience also includes layout of two boiler installations and a precipitator retrofit.

RESUME: ROBERT W. LARSON

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS

(1952 to Present)

PRELIMINARY PLANNING SUPERVISOR

SO_2 System and Baghouse Installation Study	Argonne National Laboratory Argonne, Illinois
Trimble County Power Plant Site Layout	Louisville Gas & Electric Co. Louisville, Kentucky
Mill Creek Power Plant Site Site Layout	Louisville Gas & Electric Co. Louisville, Kentucky
Standard Cycling Plant Site Layout	Commonwealth Edison Company Chicago, Illinois
Power Plant Layout for Chemical Complex	Oriente Petrochemical Complex Venezuela
Power Plant Layout for SASOL Project	South African Coal, Oil, and Gas Corporation
Steam Plant Layout for Chemical Complex	Chemplex Corporation Clinton, Iowa
Precipitator Installation	Abbott Laboratories North Chicago, Illinois

MECHANICAL DESIGN & DRAFTING GROUP LEADER

Enrico Fermi Nuclear Power Plant, Unit 2	Detroit Edison Company Detroit, Michigan
Sun Desert Nuclear Power Plant Layout Study	San Diego Gas & Electric Co. San Diego, California
Kewaunee Nuclear Power Plant	Wisconsin Public Service Corp. Madison, Wisconsin
Boiler Installation at Chemical Plant	General Mills Chemicals Kankakee, Illinois

PIPING DESIGNER AND CHECKER

Encina Power Plant Units 1, 2, & 3	San Diego Gas & Electric Co. San Diego, California
South Bay Power Plant Units 1, 2, & 3	San Diego, Gas & Electric Co. San Diego, California

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (Cont)

(1952 to Present)

Blount Street Station	Madison Gas & Electric & Co. Madison, Wisconsin
Allen S. King Generating Plant	Northern States Power Company Minneapolis, Minnesota
Mill Creek Generating Station Units 3 & 4	Louisville Gas & Electric Co. Louisville, Kentucky

F. H. MCGRAW COMPANY, (1951 - 1952)

PIPING DESIGNER

Power Plant for Chemical Complex	Linde Air Products Company East Chicago, Indiana

PIONEER SERVICE & ENGINEERING COMPANY, CHICAGO, ILLINOIS (1950 - 1951)

PIPING DRAFTSMAN

Minot, Fargo, Grand Forks, and Black Dog Power Plants	Northern States Power Company Minneapolis, Minnesota

FLUOR

SIDNEY MAYSTER *Resumé*

MANAGER, GENERATING PLANT SYSTEMS

DATE AND PLACE OF BIRTH:

February 13, 1922, Chicago, Illinois

EDUCATION:

Advanced Courses in Reactor Design
Northwestern University, School of Engineering, Chicago, Illinois

Graduate Studies in Mechanical Engineering
Illinois Institute of Technology, Chicago, Illinois

B.S. in Mechanical Engineering
Illinois Institute of Technology, Chicago, Illinois, 1945

SUMMARY OF EXPERIENCE:

Manages group of specialists doing initial planning, system definition, and study work on power plant projects. Previously, responsible for the overall supervision of engineering disciplines within the company.

As a generalist in environmental engineering, develops a systematic approach to problem solving, concentrating on a synthesis of disciplines both scientific and managerial with in-depth knowledge of environmental methods of systems analysis and impact assessment.

Served as project director and project manager for a Middle East client, as well as for domestic utilities. Responsible for the management of engineering and design of fossil-fuel unit projects, ranging in capacity from 100 MW to 750 MW. Developed testing procedures and supervised test team on performance tests and evaluation of results.

Responsible for the developmental study of new technology on the effects of helium on circulating equipment associated with the HTGR. Involved in the development of steam tables for heavy water and heavy water technology in application to reactors.

In charge of organizing Middle East office, which included acting as liaison between client and home office. Supervised startup of units. Began mechanical analytical department, including the training of personnel, and developing computer programs and standardized analytical techniques.

RESUME: SIDNEY MAYSTER

TECHNICAL SOCIETIES:

American Nuclear Society
Illinois Society of Engineers
Western Society of Engineers

REGISTRATIONS:

Professional Engineer: Illinois No. 62-17601,
Ohio No. 37736,
Kentucky No. 9253,
California No. 0695.

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (1974 to Present)

MANAGER, GENERATING PLANT SYSTEMS

Manages assigned engineers and specialists doing system definition design study work on power plant projects.

DIRECTOR OF ENGINEERING

Responsible for the overall supervision of engineering disciplines within the company.

SARGENT & LUNDY ENGINEERS, CHICAGO, ILLINOIS (1947 to 1974)

PROJECT DIRECTOR

Was an associate at Sargent & Lundy from 1966 to time of leaving. Set up engineering liaison office in the Middle East. Responsible for the complete organization and coordination of the office. Additionally responsible for handling the account of the American Electric Power Company, one of the largest utilities in the country. Managed, engineered, and, as included in the scope of work, supervised startup and performance testing on the following power plant installations:

Wabash River Generating Station 4 Units, 100 MW (Each) Coal-Fired	Public Service Co. of Indiana West Terra Haute, Indiana
Gallagher Generating Station 2 Units, 150 MW (Each) Coal-Fired	Public Service Co. of Indiana New Albany, Indiana
Haifa Station 2 Units, 200 MW (Each) Fossil-Fired	Israel Electric Corp. Haifa, Israel

SARGENT & LUNDY ENGINEERS, CHICAGO, ILLINOIS (CONT)

Reading Generating Station 4 Units, 325 MW (Each) Fossil-Fired 325,000 KW each	Israel Electric Corp.
Ashdod Generating Station 4 Units, 400 MW (Each) Fossil-Fired	Israel Electric Corp.
Cardinal Power Plant 700 MW Unit, Coal-Fired	American Electric Power Co. (Ohio Power Co.) Brilliant, Ohio

MECHANICAL ENGINEER

Organized and managed the mechanical analysis section, which was the first department utilizing computer programs for analytical work. Trained personnel, developed standardized analysis techniques. Also responsible for field tests and startup assistance.

FLUOR

ACHYUT V. SETLUR

Resumé

SUPERVISING STRUCTURAL ENGINEER

DATE AND PLACE OF BIRTH:

July 4, 1937, Bombay, India

EDUCATION:

B.E. in Civil Engineering
Bombay University, Bombay, India, 1959

M.S.C.E. in Structural Engineering
Purdue University, 1962

Ph.D. in Structural Engineering
Purdue University, Lafayette, Indiana, 1965

Intensive Course on Recent Advances in
Earthquake Resistant Design of Structures
Berkeley, California, 1976

SUMMARY OF EXPERIENCE:

Manages structural research and development and project structural analysis activities within the Structural Division.

Project structural engineer on Prairie Island and Kewaunee follow-on projects. Project structural analysis engineer on the FPS Standard Nuclear Power Plant (BOPSSAR).

Senior structural engineer on special structures and problems associated with fossil power plants such as hyperbolic cooling towers, chimneys, mat foundations, and dynamic and seismic analysis problems.

Supervising engineer on the development and use of computer codes for dynamic, seismic, and stress analysis using finite elements for nuclear power plant structures, including impactive and impulsive load analysis and nonlinear behavior.

Associate professor of structural engineering. Guided several Masters and Ph.D. students in their research. Consultant on several high rise and industrial structures.

Author of more than 20 papers in leading national and international technical journals.

RESUME: ACHYUT V. SETLUR

TECHNICAL SOCIETIES:

American Society of Civil Engineers
Seismic Analysis Committee, ASCE Nuclear Structures and Materials Committee
Task Group on Compressive Allowables, ASME Boiler and Pressure Vessel Code Committee

REGISTRATION:

Structural Engineer: Illinois No. 81-3962, 1975

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (1971 - Present)

SUPERVISING STRUCTURAL ENGINEER

Trimble County Generating Station, Unit 1, 495 MWe Coal-Fired Cooling Tower Blowdown Discharge Studies	Louisville Gas & Electric Co. Louisville, Kentucky
Encina Generating Station Units 1-5, Oil-Fired Intake and Discharge System Model Studies	San Diego Gas & Electric Co. San Diego, California

PROJECT STRUCTURAL ENGINEER

Prairie Island Nuclear Generating Station Two 550 MWe Units	Northern States Power Co. Red Wing, Minnesota
Kewaunee Nuclear Generating Station One 550 MWe Unit	Wisconsin Public Service Corp. Green Bay, Wisconsin

PROJECT STRUCTURAL ANALYSIS ENGINEER

Standard Nuclear Reference Plant 1300 MWe Unit Westinghouse PWR	Fluor Power Services, Inc. Chicago, Illinois

SENIOR STRUCTURAL ENGINEER

Trimble County Generating Station Unit 1, 495 MWe Coal-Fired	Louisville Gas & Electric Co. Louisville, Kentucky
Encina Generating Station Unit 5, 327 MWe Oil-Fired	San Diego Gas & Electric Co. Carlsbad, California

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (CONT)

Prairie Island Nuclear Generating Station Two 550 MWe Units	Northern States Power Co. Red Wing, Minnesota
Mill Creek Generating Station Units 3 & 4, 417 & 530 MWe Coal-Fired	Louisville Gas & Electric Co. Louisville, Kentucky

STRUCTURAL ENGINEER

Encina Generating Station Units 4 & 5, 327 MWe (Each) Oil-Fired	San Diego Gas & Electric Co. San Diego, California
Conceptual Design Study Proposed Nuclear Power Plant	San Diego Gas & Electric Co. San Diego, California
Standard Nuclear Reference Plant Babcock & Wilcox PWR	Fluor Power Services, Inc. Chicago, Illinois
Structural computer codes development. SAP, ANSYS, STRUDL, and DYNAL for power	Use of NASTRAN, STARDYNE, plant structures.

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR, INDIA (1966 - 1971)

ASSOCIATE PROFESSOR

Taught undergraduate courses in mechanics of solids and senior project work; graduate courses in structural analysis, numerical analysis in engineering, structural stability and dynamics. Guided Masters and Ph.D. students in their theses.

CONSULTANT

Static, dynamic, and stress analysis of high rise structures and industrial plants.	Engineering Consultant (India) Ltd.
	Chemical & Metallurgical Design Co., Ltd, India
	The K.C.P. Ltd, India
	Triveni Structurals, India

RESUME: ACHYUT V. SETLUR

PURDUE UNIVERSITY, LAFAYETTE, INDIANA (1965 - 1966)

VISITING ASSISTANT PROFESSOR

Taught undergraduate courses in structural analysis, graduate courses in structural mechanics. Research in shell structures and computer code development.

CONSULTANT

Wind stress analysis of 100 story John Hancock Center.	Skidmore, Owings & Merrill Chicago, Illinois

GAMMON INDIA, LIMITED (1959 - 1961)

Published Technical Papers

Dr. A. V. Setlur

1. "Computer Analysis of Folded Plate Structures" with J. E. Goldberg and W. D. Glauz, Proceedings of the Seventh Congress of Intnl. Assoc. of Bridge and Struct. Engg., August 1964.

2. "Analysis of Noncircular Cylindrical Shells" with J. E. Goldberg and D. W. Alspaugh, Symposium of Intnl. Assoc. of Shell Structures (IASS), Budapest, Hungary, 1964.

3. "Computer Analysis of Rotating Nonuniform Discs" with J. E. Goldberg, Ninth Midwestern Mechanics Conference, Wisconsin, August 1965.

4. "Stability of Large-Span Domes with Prestressed Edge Rings" with J. E. Goldberg, Symposium of I.A.S.S, Leningrad, USSR, 1966.

5. "Stability of Long-Span Folded Plate Structures" with J. E. Goldberg, Symposium of I.A.S.S, Leningrad, USSR, 1966.

6. "Nonlinear Axisymmetric Buckling of Shallow Spherical Shells" with S. K. Radhamohan, Tenth Indian Congress on Theoretical and Applied Mechanics, December, 1968.

7. "The Koyna-India Earthquake" with G. V. Berg, Y. C. Das and K. V. G. K. Gokhale, Fourth World Conference on Earthquake Engineering, Chile, January 1969.

8. "Torsion of Prismatic Concrete Members by the Finite Element Method" with A. H. Shah and A. Chatterjee, International Conference on Torsion, Shear and Bond in Reinforced and Prestressed Concrete, January 1969.

9. "Method of Initial Functions in Two-Dimensional Elasto-Dynamic Problems" with Y. C. Das, Journal of Applied Mechanics, Transactions of ASME, March 1970.

10. "Transient Response of Dam-Like Structures to Earthquake" with S. Basu, Journal of the Indian Earthquake Society, March 1970.

11. "A Mixed Finite Element Formulation for Plate Problems" with A. Chatterjee International Journal of Numerical Methods in Engineering, 1971.

12. "Nonlinear Stability Analysis of General Shells of Revolution" with S. K. Radhamohan and J. E. Goldberg, Journal of the Structural Division, ASCE, June 1971.

13. "Parametric Differentiation Method to Structural Optimization Problems" with M. P. Kapoov, Journal of the American Institute of Aeronautics and Astronautics, November 1970.

14. "Structural Optimization Using Parametric Differentiation" with P. C. Pande and M. P. Kapoor, Twenty-third Annual General Meeting of the Aeronautical Society of India, February 1971.

15. "Finite Element Method in Continuum Mechanics Problems" with A. Chatterjee, Third Matrix Methods Conference, Wright Patterson Air Force Base, Dayton, Ohio, October 1971.

16. "A New Approach to Soil-Structure Interaction Problems" with J. K. Khanna and M. Valathur, ASCE Specialty Conference on Structural Design of Nuclear Power Plant Facilities, Chicago, Ill., December 1973.

17. "Asymmetric Buckling of Thin Shells of Revolution by Parametric Differentiation Technique" with S. K. Radhamohan, Journal of Applied Mechanics, Trans. of ASME, December 1974.

18. "Some Studies on the Use of NASTRAN for Nuclear Power Plant Structural Analysis and Design" with M. Valathur, Third Colloquium on NASTRAN User's Experience, Hampton, Virginia, September 1972.

19. "Earthquake Response of a 300 M. High T.V. Antenna Tower" with M. P. Kapoor and Y. C. Das, Symposium on Earthquake Engineering, Roorkee, India, November 1970.

20. "Seismic Design Considerations for a Standard Nuclear Power Plant," presented and published in the 37th Annual Meeting of the American Power Conference, Chicago, Ill., April 1975.

21. "Seismic Soil-Structure Interaction by Finite Elements Case Studies" with V. Pandya, ASCE Speciality Conference, New Orleans La., Dec. 8-10, 1975.

22. "Bearing Pressure Under Foundation Mats due to Triaxial Seismic Excitation," with S. R. Parimi, ASCE Speciality Conference, New Orleans, La., Dec. 8-10, 1975.

23. "Nonlinear Seismic Soil-Structure Interaction Analysis of Nuclear Plant Structures," with D. V. Pathak and J. K. Khanna, 4th SMIRT conference, San Francisco, Ca., Aug. 1977.

24. "Operating Experiences on Breechings, Expansion Joints and Stack Liners for Fossil Stations," with V. P. Goel, presented and published in the 41st Annual Meeting of the American Power Conference, Chicago, Illinois, April 1979.

FLUOR

JOHN TRUITT *Resumé*

SUPERVISING ELECTRICAL ENGINEER

DATE AND PLACE OF BIRTH:

January 11, 1935, Fort Washington, Pennsylvania

EDUCATION:

B.S. in Electrical Engineering
University of Cincinnati, Cincinnati, Ohio, 1957

M.S. in Electrical Engineering
University of Cincinnati, 1966

Advanced Courses in Electrical Engineering
University of Cincinnati
University of Wisconsin

SUMMARY OF EXPERIENCE:

Project electrical engineer responsiblity on major power generation, combustion turbine, substation and other related projects. Duties include lead engineering and design responsibility, feasibility studies and estimates, evaluation and preparation of equipment specifications, and bid analysis and purchasing recommendations.

Electrical engineering experience includes computer programming, utility generation and transmission planning studies, protective relaying work, and power equipment application to the utility, petrochemical, steel, and paper industries.

Has taught at the university level and holds a first class radio telephone operator's license.

TECHNICAL SOCIETY:

Senior Member - Institute of Electrical and Electronic Engineers

REGISTRATIONS:

Professional Engineer: Ohio No. 28075
Kentucky No. 6089
Illinois No. 62-28254
California No. 7388

RESUME: JOHN TRUITT

FLUOR POWER SERVICES, INC., CHICAGO, ILLINOIS (1969 to Present)

PROJECT ELECTRICAL ENGINEER

Wastewater Project Encina Unit 5 300 MW Fossil	San Diego Gas & Electric Co. San Diego, California
Encina Unit 4 300 MW Fossil	San Diego Gas & Electric Co. San Diego, California
Substation Projects Various Sizes thru 138 kV	San Diego Gas & Electric Co. San Diego, California
Gas Turbine Units Various Sizes thru 60 MW	San Diego Gas & Electric Co. San Diego, California
Fuel Oil Storage Facilities Various Sizes thru 160 km^3	San Diego Gas & Electric Co. San Diego, California
Engineering Studies	San Diego Gas & Electric Co. San Diego, California

ELECTRICAL ENGINEER

South Bay Unit 4 240 MW Fossil	San Diego Gas & Electric Co. San Diego, California
Substation Projects Various Sizes thru 138 kV	San Diego Gas & Electric Co. San Diego, California
Gas Turbine Projects Various Sizes thru 30 MW	San Diego Gas & Electric Co. San Diego, California
Fuel Oil Storage Facilities Various Sizes through 89 km^3	San Diego Gas & Electric Co. San Diego, California

CINCINNATI GAS & ELECTRIC COMPANY (1962 - 1969)

ASSOCIATE ELECTRICAL ENGINEER

Scientific computer programming, generation reserve level studies, transmission planning studies, transmission loss studies, and protective relaying work.

RESUME: JOHN TRUITT

UNIVERSITY OF CINCINNATI (1964 - 1969)

LECTURER ON ELECTRICAL ENGINEERING

Taught basic circuit analysis and professional engineering license review courses.

ELLIOTT COMPANY, DIVISION OF CARRIER CORP. (1957 - 1962)

APPLICATION ENGINEER

Field sales and application of power apparatus to the utility, petrochemical, steel, and paper industries.