ROGERS ENGINEERING CO., INC.
ENGINEERS & ARCHITECTS
111 PINE STREET
SAN FRANCISCO, CALIF. 94111, TEL. (415) 986-6546

In reply refer to:
Z-80004-00
RL-107

August 20, 1980

Aminoil USA, Inc.
P. O. Box 11279
Santa Rosa, California 95405

Distribution:

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File: Aminoil USA (1/o)

File: RL-107 (1/o)

Attention: Mr. W. D. McVicker
Construction Department Manager

Subject: Concept Design - Future Geothermal Steam Gathering Systems

Reference: Aminoil Letters to Rogers - File Code 1660-12 - Dated 8/8/80

Gentlemen:

In response to your letter dated August 8, 1980, Rogers Engineering is pleased to indicate an active interest in providing the engineering services required for the subject project.

The enclosed qualification data and brochure is indicative of the geothermal experience and background Rogers Engineering can bring to such a project.

I trust that the enclosed information is sufficiently responsive to your requirements and that we may look forward to an early reply to our indicated interest in the project.

If you have any questions or require additional information, please contact us at your convenience.

Very truly yours,

ROGERS ENGINEERING CO., INC.

F. D. Dunn
Vice President

FDD:dwm

Enclosures

DISCLAIMER

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Rogers

**QUALIFICATIONS FOR
ENGINEERING SERVICES
ON
GEOTHERMAL PROJECTS**

Prepared for

**Aminoil USA, Inc.
Santa Rosa, California**

By

**Rogers Engineering Co., Inc.
San Francisco, California**

August 1980

Rogers

CONTENTS

- 1.0 GENERAL
- 2.0 ROGERS STAFF
- 3.0 PROJECT APPROACH AND ORGANIZATION
- 4.0 GEOTHERMAL PROJECTS
- 5.0 PERSONNEL RESUMES
- 6.0 BROCHURE

Rogers

QUALIFICATIONS FOR
ENGINEERING SERVICES
ON
GEOTHERMAL PROJECTS

1.0

GENERAL

Rogers Engineering Co., Inc. (Rogers) with headquarters in San Francisco, California, is a completely integrated engineering-architectural firm providing consulting and design services to clients in industrial, chemical and petrochemical fields and to the utility industry for electric power generating plants and power transmission and distribution systems.

The firm was founded in 1946 and entered the geothermal resource field in 1961 and from that date forward has performed services for clients extending from management and supervision of resource exploration and well drilling and testing programs, through feasibility studies, design of production field gathering and injection systems and geothermal electric power generating plants, to and including construction management and facilities startup. By the end of 1980, Rogers will have participated in the engineering for over one-third of the capacity of the world's geothermal electric generating plants.

Descriptions of selected geothermal projects which the firm has successfully completed and other projects demonstrating capability in piping system analysis and design are included in Section 4.0 for reference.

Rogers

2.0

ROGERS STAFF

The compilation of the experience history in the geothermal field described above has required that Rogers maintain a staff of qualified engineering personnel who have developed background and experience in parallel with that of the firm. It is from this key group that the engineers are selected to provide the required expertise and direction to the geothermal projects are undertaken by the firm.

Rogers' staff has competency in the fields of architecture and civil/structural, chemical/process, electrical, mechanical, instrumentation and control engineering disciplines. In addition, procurement services and economic analyses capability are available in-house.

Resumes of key personnel who have the required background and would be assigned to contribute to the project as required are included in Section 5.0 of this brochure.

Rogers

3.0 PROJECT APPROACH AND ORGANIZATION

Rogers uses a project management, staffing and organization concept in the performance of all projects completed by the firm.

3.1 Project Manager

The project is carried out under the direction of a Project Manager, normally selected from the staff because of his experience as related to the project requirements. He is responsible for coordinating and disseminating all project criteria and data to the key technical personnel assigned to the project. He is also responsible for execution of the project to the satisfaction of the Client requirements and within the budget and time schedules established. He is further responsible for all interface with the Client and his representatives.

3.2 Project Staff

Engineers, designers, technicians, and specialists experienced in the type of work involved are assigned to the Project Manager from the various disciplines as required.

Rogers

3.3 Quality Control

Rogers Engineering Review Board is responsible for quality control on all projects performed by Rogers and is comprised of the heads of the discipline departments with the Manager of Engineering as Chairman. No project is released from the firm until it has been reviewed and approved by this Board.

3.4 Firm Principal Participation

A Corporate Sponsor normally an officer of the corporation is selected and is responsible to monitor and insure that the project is carried out in accordance with client requirements and Rogers' corporate practice. He provides guidance to the Project Manager and assists ensuring that manpower and advisory services are available to the project.

Rogers

4.0

GEOHERMAL PROJECTS

The following pages give brief descriptions of selected geothermal projects which the firm has successfully completed and other pertinent projects which demonstrate capability in piping system design and analyses.

Rogers

PROJECT

Steam Pipeline Study
Philippine Geothermal, Inc.
Manila, Republic of Philippines

Description

Rogers was retained to develop a concept design and an evaluation study for five alternate geothermal brine piping and steam-separator system configurations for collecting hot geothermal well water from a field of 22 production wells and delivering steam to two dual pressure 55 MW turbine-generator units using a two stage flash steam separator system. Included as an integral part of the concept design and evaluation study were the brine disposal pumping and piping systems associated with each configuration considered, which are required for disposal of the cooled brine by discharge into eight strategically located injection wells.

Concept design was based on production well flow and performance data, well and power plant locations and topographic information provided by the Client.

Each concept design configuration considered different locations for the high and low pressure steam-brine separators relative to each other and to the power plant. Pipeline sizes were calculated based on the length of lines, steam-separator locations of the individual configurations and the allowable pressure drop from the initial wellhead pressure (130 psia) to the turbine inlet valve pressures (05 & 25 psia). Pipe sizing involved flow and pressure drop analysis and calculations for liquid, vapor and two-phase (flashing) flow conditions.

Comparative cost estimates were developed for each of the configurations and in addition the operating requirements and features of each system were analyzed.

The results of the concept design study and analysis, complete with recommendation of the optimum concept system design configuration based on overall cost and operating feature evaluation, were summarized and presented in a formal report.

**Construction
Cost**

Not Available

Rogers

PROJECT

HGP-A Wellhead, Proof-of-Feasibility Project
3 MW Geothermal Unit-Liquid Dominated Resource
Pohoiiki, Island of Hawaii

Description

Rogers Engineering was retained by the Research Corporation of the University of Hawaii (RCUH) to supply engineering design, construction management and technical start-up services for this geothermal wellhead power plant. The project is divided into the following phases:

- I - Concept
- II - Detailed Design and Procurement
- III - Construction Management
- IV - Start Up and Training At Site

The conceptual design incorporated optimization studies based upon well conditions and other data supplied by RCUH to determine sizes, capacities and state points to be used in the detailed design of the power plant. Additionally, site and architectural drawings and process flow and electrical single line diagrams were developed in sufficient detail to illustrate the power plant systems' operations. Ancilliary mechanical and electrical systems required for plant operations were defined and environmental safeguards were established for incorporation in the final design of the plant.

Final design and construction drawings were based on the plant concept and issued for completion by construction contract monitored and controlled under the construction management program.

**Construction
Cost**

U.S. - \$8,000,000

Rogers

PROJECT

Brawley Geothermal Power Plant
1 10-MW Geothermal Unit, Liquid Dominated Resource
Brawley, Imperial County, California

Description

This geothermal power plant was built by Union Geothermal Division for eventual ownership by Southern California Edison Co. Rogers was retained by Union to perform all engineering, design, procurement and construction management services including a conceptual design and cost estimate for the plant. This was followed by a more refined preliminary design and cost estimate including obtaining firm quotations for the turbine/generator, condenser, vacuum equipment and main step-up transformer.

Rogers prepared final design and construction documents for the plant and procurement of equipment. Orders were placed for the major equipment and construction contracts awarded for the balance of plant.

The design and construction of the plant was completed on an accelerated schedule, and the plant was turned over to the client within 24 months. Performance on this plant is illustrative of Rogers ability to "fast track" a project.

**Construction
Cost**

U.S. - \$10,000,000

Rogers

PROJECT

**Krafla Geothermal Power Plant
Icelandic Krafla Geothermal Power Plant Committee
Krafla, Iceland**

Description

Rogers was retained by the Krafla Geothermal Committee of Iceland in joint venture with an Icelandic civil engineering firm for the design of a 60 MW (two 30 MW units) geothermal electric power generating plant. The plant was designed for dual pressure steam turbine (double flash, two pressure steam system) and was a totally enclosed plant because of the extreme climate of the site. The seismic conditions were a major consideration for the structural systems design. Procurement of equipment and materials was made on an international basis.

Services provided by Rogers included preparation of concept design and feasibility studies, preliminary and final design for the mechanical and electrical systems, procurement, construction management, start-up and operator training assistance.

**Construction
Cost**

U.S. - \$30,000,000

Rogers

PROJECT

The Geysers Geothermal Project - Units 7 and 8
The Geysers, Sonoma County, California
Pacific Gas and Electric Company
San Francisco, California

Description

Units 7 and 8 generate a gross electric power of 110 megawatts. This plant is one of the largest geothermal generating plants in the world.

Rogers Engineering Company, Inc. was retained to provide the complete design for the construction and installation of the two 55 MW units (Units 7 and 8). Some of the specific elements performed by Rogers Engineering included: site studies and final siting of the powerhouse, cooling tower, step-up transformer substation and other site related equipment based on economic earthwork analysis, optimum access approach analyses and topography data obtained from the site; preparation of design and construction drawings and specifications for: all foundations, structures, powerhouse building, cooling tower basin and equipment foundations and supports; piping systems for steam, cooling water, lubrication, fire protection, etc., including thermal and seismic piping stress analysis and location and design of required system anchors and restraints; complete interior and exterior electrical power distribution, supervisory control and lighting systems, building mechanical systems; and general plant instrumentation and control systems including interfacing with vendor supplied control packages.

After construction contracts were awarded, Rogers provided consulting services in interpretation of plans and preparation of field sketches required to accommodate to field conditions, reviewed and evaluated Contractor- and Owner-generated construction change orders to provide the client with construction cost control.

Construction Cost \$12,000,000

Rogers

PROJECT

The Geysers Geothermal Project - Units 5 and 6
The Geysers, Sonoma County, California
Pacific Gas and Electric Company
San Francisco, California

Description

Rogers Engineering Co., Inc. was retained to provide the architectural, civil, structural, design and construction drawings for the geothermal power plant known as "Units 5 and 6." In addition, we provided for this project the mechanical and electrical design drawings relating to the power plant building facilities.

The work performed by Rogers Engineering was basically a support service to the Engineering Department of Pacific Gas and Electric Company, and was originated in view of the large design load of the power company and the short time requirements for producing the construction and bid documents for this project.

The project involved development of complete construction drawings, survey data reduction, project control, design of structural elements, as well as architectural requirements for the building. The site grading for this project was of major importance due to the location of this plant on what had been a mountainous ridge which had to be graded level so that there was sufficient room, not only for the power plant and its cooling tower basin, but also an access road.

This plant, at the time of its design, was the largest geothermal plant to be designed and built, in the world, and was the predecessor for Units 7 and 8, and 9 and 10, which have been subsequently designed and built.

Construction Cost \$12,000,000

Rogers

PROJECT

**Tiwi Philippines Geothermal Power Plant
2 55-MW Geothermal Units, Liquid Dominated Resource
Tiwi, Albay, Luzon, Philippines**

Description

Rogers prepared a preliminary power plant design and developed specifications for major equipment, issued requests for quotations, received and evaluated quotations and made recommendations to the Owner. After evaluating the well test data and chemical composition of the geothermal waters, Rogers determined a double flash system to be most appropriate for this plant and proceeded with the preliminary design and specifications on that basis.

Included in the design work were a heat and material balance, piping and instrument diagrams, electrical single line drawings, mechanical and electrical equipment layout and overall architectural design of the plant. Final design of the plant was accomplished essentially in accordance with the design prepared by Rogers Engineering.

**Construction
Cost**

U.S. - \$66,000,000

Rogers

PROJECT

**POL Pipelines for Ship Refueling
The United States Navy
Subic Bay Naval Base**

Description

Two 3-mile long, parallel, 12-inch diameter, buried steel POL Pipelines to carry diesel fuel oil from an unloading fuel-pier to a docking and service pier. This included a half-mile wide submarine crossing, and a diesel fuel clarifier station. Also, a single 3-mile long 10-inch diameter, buried steel POL Pipeline to carry heavy fuel oil from the same unloading fuel-pier to an aircraft carrier docking pier. A single pumping and metering station and telephone communication system served all three pipelines. The lines were wrapped and cathodic protected. Complete engineering design and construction supervision supplied under a negotiated lump sum contract.

Construction Cost

Not available

PROJECT

**Pipeline - Subic Bay to Clark Air Base
U. S. Navy
Manila, Philippine Islands**

Description

For many years, petroleum products for Clark Air Base, the major United States Air Force base in the Philippines, were delivered by truck over a 65-mile route from the Bataan Ocean Petroleum Depot in Manila Bay. The increased requirements for aviation fuels brought about by the Vietnam conflict made it impractical and inefficient to continue delivery in this method.

Rogers Engineering, Co., Inc., conducted a feasibility study of a pipeline to go from the Subic Bay Naval Station to Clark Air Base, a distance of about 40 miles. After several alternative routes and systems were considered, Rogers completed design of a 10-inch multiproduct pipeline for delivery of AvGas and JP-4 fuel that would span the 40 miles from Subic Bay to Clark Air Base.

The line was designed and constructed with two parallel 500-hp multistage centrifugal pumps operating at a working pressure of 800 psi, and met the requirements of 1,046,000 gallons per 16-hour pumping day.

Operation of this pipeline has resulted in a major cost savings by the U. S. Navy.

Construction Cost

Not available

Rogers

PROJECT

Air Base Hydrant Refueling Projects

USAF, Anderson AFB, Guam, M. I.

USN, Naha Air Base, Okinawa, R. I.

Description

Complete design of 3-product, semi-underground, high-pressure terminal, tank farm, and pumping station survey, evaluation, reloading, and redesign of 15 miles of 14-inch and 8-inch product lines; review and revision of pipeline control and communication system; design of electric power system; inspection of construction.

Design of underground storage tanks, 19 miles of 6-inch product transfer pipeline, double truck loading facility, manifold for 4-product transfer pumping station, electric power for the facilities and inspection of construction.

Design modifications for POL storage, transfer and dispensing facilities including redesign and relocation of 20 miles of 8-inch product and water pipelines, dockside tanker unloading facilities (4-product), design of a pipeline control and communications system and electric power supply. Work included inspection of construction.

Design of 7-product undersea tanker unloading facility, including connection of island-wide grid, undersea POL lines, tanker moorings, undersea ship-shore communications system and inspection of construction.

Design of five 2-product unloading storage and truck loading facilities including POL transfer lines from tankage to pier, pier to unloading points, design of tankage, truck loading and drum-filling facilities.

Design of 7-product, ship-unloading booster station including semi-underground pump-house, machinery and manifold; connecting pipeline to shore valve-box, engine auxiliary piping, sanitary plumbing and electrical facilities.

Construction Cost Not available

Rogers

PROJECT

**Airport Hydrant Refueling - Commercial
Los Angeles, San Francisco and Honolulu
Standard Oil Company of California**

Description

Los Angeles: Design of a satellite tank farm consisting of 23 underground horizontal, cylindrical tanks, each equipped with a vertical product pump. Supplied by five pipelines from a bulk storage area. Includes eleven filters supplying eighty-three hydrants. A tank truck loading rack with two truck loading spots. Electric power supply, distributions, controls and lighting.

San Francisco: Design of a satellite tank farm consisting of twelve 10 foot 6 inch diameter by 38 foot 6 inch horizontal above ground tanks for storage of four grades of Av-gas and jet fuel supplied by one 3-inch and one 4-inch product line from bulk storage area. Eight product transfer pumps; five product pipelines from the satellite tank farm to the concourse area; sixty-two hydrants at concourses "B", "C" and "D"; a tank truck loading rack with two truck loading spots; and electric power supply, distribution, controls and lighting.

Honolulu: Design of a new satellite tank farm consisting of 10 underground, horizontal, cylindrical tanks for storage of Av-gas and jet fuel. A "bottom loading" tank truck loading rack with four truck loading spots; six product transfer pumps; seven filter separators; an oily water separator; fifty hydrants; and electric power supply distribution, controls and lighting.

**Construction
Cost**

Not Available

Rogers

5.0

PERSONNEL RESUMES

The following pages present names of key personnel on the Rogers staff having pertinent background on geothermal projects and who would be expected to contribute to geothermal projects on an as-required basis.

Rogers

FRED D. DUNN

POSITION

Vice President

EXPERIENCE

Mr. Dunn has over thirty-five years of experience in all phases of engineering design and project management of electric power, industrial, and process facilities for public utilities, industrial complexes and government installations, in both domestic and international applications.

As a firm principal in charge he has been responsible for the supervision of the preparation of feasibility studies, economic analyses, and conceptual, preliminary, and final design for a multitude of projects in the fields of electric power generation and distribution, steam generation and distribution systems, petroleum products storage and transfer facilities, and miscellaneous chemical process and industrial manufacturing plants.

On electric power generating projects Mr. Dunn has performed as firm principal and/or engineer in charge for preparation of design and construction drawings for (a) four hydroelectric power plants (120 MW each); (b) a major heavy fuel-fired total energy diesel-electric plant (50 MW); (c) several geothermal electric power generating plants including a single wellhead unit (3 MW) in Hawaii, a two unit (30 MW each) 60 MW plant in Iceland, a single unit 10 MW plant in California's Imperial Valley, two 2-unit (55 MW each) 110 MW plants at PGandE's Geysers geothermal power plants in California; and (d) a number of small diesel-electric stations (5 MW +) and standby and emergency power installations for utilities and government installations.

In the geothermal field, Mr. Dunn has been directly involved in the performance of a geothermal well testing and report program for a geothermal well in California's Imperial Valley; preparation of well drilling contracts and procurement of drilling accessories and tools for a well drilling program in the Philippines; preparation of numerous studies and publications on geothermal conversion systems and gathering and injection systems analyses and evaluations; and in development of feasibility studies, preliminary designs and cost estimates for numerous geothermal power generating plants.

Mr. Dunn's background also includes environmental engineering and pollution abatement studies and projects for H₂S abatement at geothermal power plants, solid and gaseous waste incineration, industrial fume control and chemical and industrial waste treatment facilities.

EDUCATION

University of Nevada, Bachelor of Science, Mechanical Engineering

REGISTRATION

Professional Mechanical Engineer, California, Nevada, Arizona and Montana

MEMBERSHIP

Consulting Engineers Association of California

Rogers

H. I. ROGERS

POSITION

Senior Electrical Engineer
Vice President

EXPERIENCE

Mr. Rogers has had extensive experience in the electric utility and computer applications fields. He has professional experience in planning, engineering design, economics, systems analysis and management of projects.

Geothermal project experience includes: management, specification, design criteria, capital and operating cost determinations, cost of electric power, project financing and overall economic analysis.

Electric Utility experience has been gained in consulting to and being an employee of investor owned, municipal and government owned systems. He has conducted and participated in field investigations, technical studies, and implemented electric system improvements and expansion projects to meet existing and future system load requirements. In planning the system requirements, his experience has included the total utility electrical situation from load development through transmission line design, routing and planning; economic evaluation of various generation methods; and schemes to coordinate with load characteristics and requirements. Electric utility technical analysis includes: load flow, short circuit, and transient stability studies. Distribution work has been in operations, planning and design.

Economic Studies include: power supply contracts, wheeling agreements, rate structures, engineering economic alternatives, generation operating cost alternative comparisons, utility plant appraisal, project capital costs, cost of power and international project financing.

Computer Applications have been used extensively. They include: system analysis and program writing in electrical and mechanical engineering, economics, business accounting, and public utility technical studies. Project scheduling and control has been implemented by use of critical path scheduling techniques.

Legal Research in the utility field relating to administrative and statute law of government power projects, regulatory commissions (FPC, CPUC, CERDC), and contractual regulations. This information was utilized in engineering and economic work.

Rogers

H. I. ROGERS (Cont'd)

EDUCATION

Whitman College 1959-62, Walla Walla, Washington
Arizona State University, BSE 1964, Tempe, Arizona
University of Santa Clara, MSEE 1970, Santa Clara, California
Stanford University, 1976, Utility Economics, Stanford, California

REGISTRATION

Professional Electrical Engineer, California

MEMBERSHIP

Institute of Electrical and Electronic Engineers - Power Society
National Society of Professional Engineers
Consulting Engineers Association of California

Rogers

BRUCE FRASER

POSITION

Chief, Chemical & Process Department

EXPERIENCE

Mr. Fraser has over forty years experience in all phases of process and power plant design, construction, start-up, production operations, process improvements, and air and water pollution abatement.

He is responsible for process engineering in the design of geothermal power production facilities including standards for well testing and evaluation; heat and materials balance for power cycle diagrams and process flow diagrams; evaluation of turbine condensers and noncondensable gas removal systems; application and evaluation of environment abatement processes applicable to the disposal of geothermal waste water and noncondensable gas including H_2S ; and application of Rogers' process system for handling calciting geothermal waters.

He is also responsible for evaluation of turbine condenser heat sink systems including: dry cooling systems (radiators), mechanical draft cooling water towers, cooling ponds and canals, river, lake and sea water circulation.

Mr. Fraser provided process engineering services on the Geysers Units 7 and 8 and the Krafla, Iceland 60 MW geothermal power plant. Most recently, he has directed or performed process design for 10 MW and 3 MW geothermal power plants including H_2S abatement for the latter.

His experience in pollution abatement projects includes:

Removal of chlorine, sulfur chlorides and sulfenyl chloride from the exhaust air system of a semi-works fungicide plant and from a similar full-scale fungicide manufacturing facility, plus additional disposal of liquid chlorinated sulfur compounds via dual liquid gas incineration and a flue gas scrubbing unit.

A field survey and plan to handle industrial wastes at Sharpe Army Depot, involving degreasing, chromate stripping and solvent removal units, and a similar, but more comprehensive plan for the Riverbank Army Ammunition Depot including waste water clarification, sludge dewatering and disposal and thermal reduction.

The collection and disposal of relief vent gases from petroleum processing which included a liquid interceptor and vent stack with smokeless flare.

Design of a process to remove H_2S from turbine exhaust steam at PGandE's Geysers' Power Plant.

Rogers

BRUCE FRASER (Cont'd)

Mr. Fraser was the technical adviser for a coal gasification conceptual design program for Lawrence Livermore Laboratory (LLL). This project involved process engineering consulting services for optimum system control design to provide maximum safety for equipment and personnel during the operation of LLL's steam/oxygen injection test for in-situ coal gasification experiment at the Hoe Creek, Wyoming test site.

EDUCATION	B. S. in Chemical Engineering, University of California
REGISTRATION	Professional Chemical Engineer, California
MEMBERSHIPS	American Chemical Society Instrument Society of America

Rogers

JOHN H. G. STUART

POSITION

Staff Consultant
Mechanical Department

EXPERIENCE

Mr. Stuart's professional career embraces more than thirty-five years experience in the operation, maintenance and design of geothermal and fossil fuel electric generation plants, marine propulsion equipment and aerospace test facilities.

For the Krafla Geothermal Power Plant in Northern Iceland, Mr. Stuart served as mechanical project engineer, and in this capacity developed the design and carried it through to completion. His work included preparation of specifications and procurement documents, evaluation of bids, monitoring vendor submittals and progress and providing support to the construction effort, both from the home office and through considerable time spent at the project site. Additionally, Mr. Stuart was in residence at the site throughout the start-up period and made significant contributions to this phase of the project as well as training of the permanent operating staff. The Krafla project consists of two 30 MW steam turbine-generators with turbines of the double flow mixed pressure condensing type.

Mr. Stuart was successively senior construction engineer, facility design engineer, supervisor of facility design and construction, and senior research engineer with Lockheed Missile and Space Co., Sunnyvale, California, and was responsible for the design, installation and test of several facilities for development and test of very high pressure, high flow, gas and hydraulic equipment, cryogenic, vacuum and power facilities.

Prior to joining Lockheed, Mr. Stuart was technical assistant, mechanical, with Pacific Gas and Electric Co. and was responsible for planning and economic analysis for the turbine-generator and boiler overhaul and maintenance program for the entire Pacific Gas and Electric system of seven million kilowatts installed capacity.

His experience includes service with the Calcutta Electric Supply Corp. in India as boiler and turbine house superintendent in three steam-electric power plants where he was responsible for operation, maintenance and construction for over five years.

Mr. Stuart's professional career began with seven years service in the Royal Navy with assignments including chief engineer officer and inspector of naval machinery.

Rogers

EDUCATION

University of Dublin, Trinity College
B. S. Mechanical Engineering
M. S. Mechanical Engineering

University of London, Imperial College
Diploma in Generation, Distribution and Utilization of
Electric Power

Hartnell College, Salinas
Industrial Electronics

REGISTRATION

Chartered Mechanical Engineer
Great Britain

MEMBERSHIPS

Member, Institution of Mechanical Engineers
Electrical Power Engineers Association
American Society for Metals
American Vacuum Society

Rogers

JOHN A. BICKERSTAFFE

POSITION

Senior Engineer
Mechanical Department

EXPERIENCE

Mr. Bickerstaffe's background covers ten years of experience in design and design supervision of mechanical systems and facilities for geothermal, petroleum refining, chemical process, and power generating plants. He has performed in various areas of project responsibility from design coordination and control to project management tasks.

Mr. Bickerstaffe has been responsible for the preparation of: process flow diagrams; P&ID's; engineering calculations; equipment, piping, and valve specifications and bid requests; and bid analyses and purchase recommendations for mechanical equipment and systems associated with process and power generating facilities.

Mr. Bickerstaffe performed as project manager and coordinator on the following:

- a twin 300 HP boiler modernization project for the U. S. Navy
- a 2,400 gpm high speed aircraft fueling project for a U. S. Navy installation in Hawaii and also one in California
- A nonelectric application study of geothermal energy for a California municipality
- Project coordination of miscellaneous system studies for geothermal power plant application at PGandE's Geysers Plant in California.

Mr. Bickerstaffe's design background on other projects includes design of piping systems and equipment selection and specifications including cost estimates for several geothermal flash steam plants ranging in size from a 10 MW plant in California to a 60 MW plant located in Iceland. Other projects include natural gas compressor station, pilot plants for plastic materials research, and a major fuel storage facility design associated with copper refining.

EDUCATION

Graduate of Lanchester College of Advance Technology in Coventry, England - Mechanical Engineering

REGISTRATION

Professional Mechanical Engineer, California

Rogers

HERBERT LORENZEN

POSITION

Supervising Engineer
Electrical

EXPERIENCE

Mr. Lorenzen has been continuously engaged in electrical engineering design work for over thirty years. He has had extensive experience in the design of electrical facilities for metalurgical and manufacturing plants, public utilities, commercial buildings and naval vessels.

He was responsible for the electrical design of a 110 MW geothermal steam generating plant (PGandE Geysers Geothermal Power Plant, Units 7 and 8), including installation of turbine generators, control switchboards, alarms and automatic shutdown controls, auxiliary power to pumps and cooling towers, and plant lighting.

Subsequently, Mr. Lorenzen had partial responsibility for the electrical design of a 60 MW geothermal steam generating plant, the Krafla Geothermal Power Plant in Iceland, including design of installations for auxiliaries, controls and a 132 kV switchyard to serve the outgoing lines.

In the industrial field, Mr. Lorenzen has designed the power, lighting and control systems for metalurgical, fertilizer, cement, paint and asbestos, and cast iron pipe manufacturing plants and foundries. He is particularly well qualified in the design of complex control systems to satisfy varying manufacturing and process system requirements.

Mr. Lorenzen developed the criteria for and supervised the design of the power supply and distribution systems for a major oil refinery. He selected the power source, developed loads, and prepared the network analysis. He also made recommendations on equipment selection and prepared system operating and maintenance instructions. This work was an extension of previous experience in the design of refinery power, distribution and control systems.

In the public utilities field, Mr. Lorenzen has supervised the design of a number of high voltage transmission and distribution substations. This work has included metering, relaying, control, and low voltage distribution.

EDUCATION

University of California, Bachelor of Science in Electrical Engineering, 1933

REGISTRATION

Professional Electrical Engineer, California

Rogers

MICHAEL O'NEILL

POSITION

Planning, Scheduling and Cost Engineer

EXPERIENCE

Mr. O'Neill's experience includes serving as project manager or design engineer for various commercial and industrial facilities and utility projects involving design and construction services for underground and overhead power distribution systems. His duties for most of these projects included preparation of construction cost estimates at the discipline level, as well as the project level.

His experience also includes design engineering, specification preparation, bid evaluation and preparation of construction cost estimates for several geothermal power plants and field services during construction on a power plant constructed in Iceland.

He has spent considerable time on computer program development and application to construction cost estimates. The programs are developed based upon various systems of accounts. The programs take into account proposed construction schedules and facilitate constant re-evaluation of cost parameters such as contractor overhead and profit and time of material and labor dollar disbursement with reference to the date of estimate preparation. Costs of the project with respect to long lead time items can be accurately coordinated with other project requirements. Major schedule modifications can be easily accommodated by the program and cost effects of the change can be realized very quickly. This enables the production of construction cost estimates based upon proper application of estimate cost factors over and above basic material and labor, and allows these factors to be easily adjusted with respect to changing conditions.

Mr. O'Neill has also been active in planning and scheduling activities including computer applications to these functions. He has recently developed a comprehensive schedule for a major project involving numerous permitting agencies as well as a complex design/construction activity.

EDUCATION

California Polytechnic State University, San Luis Obispo, Bachelor of Science in Electrical Engineering

West Valley Junior College, Saratoga, California, Associate of Science Degree

MEMBERSHIP

Institute for Electrical and Electronic Engineers

REGISTRATION

Professional Electrical Engineer, California

Rogers

AURELIO T. ALEGRIA

POSITION

Chief, Civil/Structural Department

EXPERIENCE

Mr. Alegria's twelve years of experience in civil/structural engineering include work on geothermal and fossil fueled power plants, industrial and commercial facilities and institutional and residential structures. He has performed lateral force analyses for major power plant structures and has employed computer programs where applicable. A recent major assignment was design of the power house for the Los Banos Geothermal Plant constructed near Manila in the Philippines. For this project, he also designed miscellaneous structures associated with the power plant, including support structures for a large bridge crane, foundations for the switchyard and other outdoor equipment.

In his most recent project assignment, Mr. Alegria has been in charge of all civil and structural engineering for a 10 MW geothermal power plant to be constructed in the Imperial Valley. Mr. Alegria has engaged in structural design for radio transmitting towers, electrical high tension wire structures; and varied underground facilities including electric vaults, electrical duct banks, steam and miscellaneous utility lines.

In addition to civil and structural engineering work, Mr. Alegria has been active in pipe stress analysis and has performed this function for three geothermal power plants. He has become well versed in the application of computer techniques to pipe stress analysis and has employed programs available through local computer service companies.

EDUCATION

Mapua Institute of Technology (BSCE), 1968
Manila, Philippines

REGISTRATION

Professional Civil Engineer, California
Professional Civil Engineer, Philippines

MEMBERSHIP

Professional Engineers' Association of the Philippines

GEOHERMAL RESOURCE DEVELOPMENT & UTILIZATION

ROGERS

Engineering • San Francisco

UPDATE

GEOHERMAL RESOURCE DEVELOPMENT AND UTILIZATION PROGRAMS

INTRODUCTION

In response to many requests, this UPDATE has been prepared to outline the ROGERS approach to geothermal resource development and utilization. It is an approach designed to eliminate unnecessary expenditures through maximum use of existing information, highly selective use of exploration methods, and integrated data analyses to locate the optimum drill site for the first test well. For budgeting and operations, the total program is divided into exploration, development, feasibility, and utilization programs.

EXPLORATION

An exploration program is prepared and budgeted after a data search and a field reconnaissance have been made to determine the nature of the potential geothermal resource area. Using the conclusions drawn from these studies, a staged program is scheduled and budgeted. Such a program may include geologic, geohydrologic, geochemical and geophysical surveys, with a controlled approach, that as data is collected and analyzed, some surveys may be eliminated or expanded as required to select an optimum drilling target.

DEVELOPMENT

The first stage of the development program is to drill a test well at the site selected in the exploration program. If a geothermal reservoir is located by this well, well tests are run to evaluate the characteristics of the resource. Assuming the tests on the first well indicate a commercially producible resource, it is usual to drill and test at least two other wells in the same reservoir to provide adequate data for a reservoir assessment. This assessment will provide information on the characteristics of the reservoir and reservoir fluids, producing capacity, optimum well spacing, well design and probable life.

FEASIBILITY

The data from the reservoir assessment is used to prepare technical and economic feasibility studies for the use of the resource to generate electric power or other uses. In addition to evaluating the feasibility of production of electric power by various power cycles; or steam or hot water for domestic or industrial uses at a site, the studies must include power transmission systems and costs, competing sources of energy, and environmental considerations.

UTILIZATION

If feasibility is shown, the utilization program may proceed. This will involve facility design, plans and specifications, material and equipment procurement, management of construction, start-up and operator training.

UPDATE

September 19, 1977

CITY OF DESERT HOT SPRINGS GEOTHERMAL PROJECT

San Francisco -- H. Rogers, Jr., President of Rogers Engineering Co., Inc. announced today that the First Quarterly Report for Phase I of the Desert Hot Springs Project, which is being sponsored by ERDA and the California Energy Commission (CERDC), has been published. This project involves the parametric analysis and selection of candidate systems for field demonstration. The selection will be based on social, economic, institutional, and environmental (SLIE) analyses of the nonelectric (direct heat) applications of geothermal resources underlying The City of Desert Hot Springs, California.

Rogers Engineering Co., Inc. and the Jet Propulsion Laboratory of the California Institute of Technology are serving as consultants to The City of Desert Hot Springs in this effort.

The Quarterly Report covers all the technical activities which have been carried out to date. ROGERS' primary activity during this period was to manage a well flow test of the geothermal well at Two Bunch Palms Spa. This test program developed data on the characteristics of the brines produced and the productivity of the well. Preliminary results indicate that the geothermal energy resource is sufficient to support commercial development.

The "SLIE issues" to be evaluated include the analysis of community needs, characterization of the resource underlying The City of Desert Hot Springs, assessment of the agribusiness market, greenhouse design, load survey of space conditioning and a space conditioning applications analysis.

UPDATE

PRESS RELEASE

AUGUST 31, 1977

Contact: James T. Kuwada
415/986-6546

IRANIAN GEOTHERMAL SURVEY INITIATED

San Francisco -- James T. Kuwada, Vice President of Rogers Engineering Co., Inc. of San Francisco, announced today that he recently returned from a trip to Iran where he successfully negotiated a Phase I contract to detail areas of prospective geothermal resources in the regions of Sabalan, Sahand, Damavand, Khoy, and Maku in Northwestern Iran. The project areas encompass over 31,000 square kilometers, which is about 12,000 square miles.

Exploration teams are now in the areas to conduct surveys involving specialists in geology, geohydrology, and geochemistry. It is anticipated that the work in these five regions will be completed in 1978. The rugged terrain and the heavy snow and rainfall at the higher elevations in some months create a challenge for the crews to maintain the schedule.

The contract was executed by ROGERS with Tehran Berkeley, a consulting firm based in Tehran holding a prime contract with the Imperial Government of Iran. ROGERS has subcontracted with Senturion Sciences, Inc., of Tulsa, Oklahoma, and GeothermEx, Inc. of Berkeley, California, to participate in this exploration phase of this geothermal resource development project.

UPDATE

PRESS RELEASE

NOVEMBER 25, 1975

Contact: Carroll Bradberry
415/986-6546 Ext 39

San Jose, Costa Rica -- James T. Kuwada, Vice President of Rogers Engineering Co., Inc. of San Francisco, announced today that he executed a contract with I.C.E. (the Costa Rican Institute of Electricity) to assist them in a first-phase effort directed to installing the first geothermal-electric power plant in Costa Rica. This contract will be partially financed with a loan from the Inter-American Development Bank.

According to Mr. Kuwada, the first-phase effort involves an evaluation of all scientific data on geothermal resources collected by I.C.E. in the Pailas-Hornillas Zone of the Cordillera Volcanica de Guanacaste, which is in the northwestern part of Costa Rica, not far from the border of Nicaragua. This zone has active surface manifestations which indicate a prime geothermal resource. Following the data evaluation, geologic and geophysical surveys are to be conducted by I.C.E. with ROGERS' assistance, with the objective of locating the sites where exploratory wells will be drilled in the next phase of work.

As managers of this project, ROGERS has engaged specialists to assist in implementing this first-phase effort in geology, geophysics, geohydrology and geochemistry. These specialists include GeothermEx, Inc. of Berkeley, California and Dr. Henry J. Ramey, Jr. of Stanford University.

If the results of this first effort appear positive, the project will proceed through drilling and testing of exploratory wells, reservoir assessment and a feasibility study for installation of a geothermal electric power plant.