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FINAL REPORT

TECHNICAL ASSISTANCE

Contract No. ET-78-S-06-1102 TA #2

AT06-78 ET 27157

Contract Period 15 August 1978 - 14 July 1979

Gene Culver, Principal Investigator

Geo-Heat Utilization Center
Oregon Institute of Technology
Klamath Falls, OR 97601

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SUMMARY

Personnel involved in the Technical Assistance program have worked on 34 projects during the past year. A project being defined as a request for assistance that requires considerable effort, more than one or two days.

If all of the projects were carried through to completion, the resulting geothermal energy on line would be approximately 1.1×10^{12} BTU/yr. We are fairly certain that all will not be completed, in fact some are not economically justifiable and should not be completed. However, luckily the large and influential projects, Green Valley Estates in Fernley and the Las Vegas Hilton Hotel to name two outstanding ones, appear to be progressing quite satisfactorily. Several of the smaller projects such as the hospital in Caliente and apartments in Klamath Falls are actually in construction now.

In addition to the projects, many inquiries have been answered via telephone or letter after only a few hours effort. These are so numerous that we have not attempted to log or report them.

The work load increased dramatically during the year and a full time engineer, Gene Ryan, was added to the staff with 100% of his time on the Technical Assistance program.

Additionally and most important the size of the projects has increased dramatically. In the first several months requests were for assistance in home or small commercial venture, now we see the Fernley project planned for 7,000 homes plus 1800 acres of industrial complex. We predict that as fossil fuel prices continue to soar the work load will increase. We foresee in the not too distant future that location of sites will be primarily decided by available energy including geothermal in many instances here in the west.

If the workload trend continues it will be necessary to hire additional staff.

A sizeable file of consulting engineering firms interested in working in geothermal has been gathered and continues to grow slowly. To date most referrals have been to consulting geology firms to locate or verify a resource. As more projects develop toward construction, referrals to engineering firms will increase.

BACKGROUND

Under the technical assistance program up to 100 man hours of consultation can be provided, at no cost, to private, public, or corporate entities intending the direct utilization of geothermal energy. Application areas include but are not limited to, space heating and cooling, district heating, aquaculture, food production and processing, drying, chemical and pharmaceutical processes, animal husbandry, etc. Assistance will be given primarily for projects in the Pacific Region states of Alaska, Washington, Oregon, California, Nevada, Arizona, and Hawaii. Projects in other regions and large electrical power generation projects should request assistance through other technical assistance programs.

Consultation may be in the form of limited resource evaluation, engineering feasibility and economic studies, materials selection and corrosion problems, conceptual design, consultation with private engineering or consulting geologists, etc.

The program is intended to provide assistance to persons with little or no experience in the geothermal field in order to promote the rapid development of geothermal resources. The program is not intended to compete with consulting engineers and geologists and Geo-Heat personnel will not provide detailed plans, specifications or services when qualified private consulting is available.

Additionally, technical personnel are available for informational seminars or speaking engagements to interested groups, trade and technical associations, technical seminars, etc.

PERSONNEL

Personnel assigned to the project are:

Gene Culver, principal investigator, with 100% of his time devoted to the project.

Gene Ryan, mechanical engineer, with 100% of his time devoted to the project.

Other Geo-Heat and OIT personnel who have worked on the project are:

Charles Higbee, engineering economics

Paul Lienau, engineering

William Johnson, aquaculture and agriculture

John Lund, engineering

Robert Koeppen, geology

As of the end of the contract period informal authorization to extend the program has been received although no final commitments have been made. All personnel have been retained on temporary month-to-month contracts until August 15 or formal agreements have been reached.

BUDGET

See attached Appendix C.

Approximately \$8,660 in outstanding encumbrances are not included in the attachment since the actual cost of these items, ordered but not billed, is not known. Estimated unexpended contract funds will amount to approximately \$18,000. Permission to apply these funds to the new contract noted above has been requested but the request has not been approved or denied as of September 1, 1979.

TECHNICAL ASSISTANCE PROJECTS

ALASKA:

Pilgrim Hot Springs.

Attended meeting in Anchorage concerning Pilgrim and other hot springs in Alaska. Many institutional problems exist with land ownership, indian rights and desires, water quality, etc.

As one of the most promising locations Pilgrim is being pursued by Alaska Division of Power and Energy and others. Geophysical work has been done and preliminary designs for greenhouse completed. Technical Assistance program provided some consultation assistance, most work being done by Alaskan entities.

Estimated yearly use - 6×10^9 BTU/yr.

Current status - in permitting process.

Other sites.

Inquiries regarding assistance have been received from owners of three other hot springs but no information concerning proposed uses have been received and no work done on them.

WASHINGTON:

Sol Duc Hot Springs.

Preliminary design and economic analysis was done on space heating, water heating and swimming pool heating.

Estimated yearly use - 1.2×10^9 BTU/yr.

Current status - Economic and institutional issues are under study by the National Park Service since the area is almost entirely in the Olympic National Park and excluded from commercial development.

Prosser Area.

At the request of Washington Department of Natural Resources, a trip was made to Prosser to run temperature logs on two wells in the area in order to assess their value for space heating. One of the wells was inaccessible due to the pump installation and the other apparently has caved in or is blocked in some other way. Both wells are located some distance from town and probably could not be used but the temperature and flow rates suggest that if similar wells could be obtained near town some use could be made using heat pumps. More geological data is required before any more positive statements can be made.

White Swan.

A request is pending action awaiting results of negotiations between the school district who requested assistance and the Indian tribes who apparently own the resource.

Ephrata.

The city has requested assistance in heating 10 city and county buildings utilizing existing warm (86°F) wells used for the city domestic water supply.

Current status - Awaiting more information from city officials.

North Bonneville.

The city has requested assistance in designing a low temperature (≈100°F) system to heat the new city being constructed.

Current status - A trip to the site is planned.

OREGON:

Radium Hot Springs, Haines, OR.

Heating for home, small commercial greenhouse, commercial pool, and

aquaculture pond. Technical Assistance has provided consultation on methods and materials. Owner is doing most work himself.

Estimated yearly use - 5×10^9 BTU/yr.

Current status - Construction continuing planned on-line fall of 1979.

Keenan Smith Aquaculture project (shrimp), Klamath Falls, OR.

Estimated yearly use - 2×10^9 BTU/yr.

Current status - First shrimp crop harvested with lower yield than expected. The low yield was attributed to incomplete temperature control system and design work on the system and a new breeding and juvenile raising building is progressing.

Dr. Wayland Office Building, Klamath Falls, OR.

Space conditioning of 10,000 sq. ft. building utilizing heat pump.

Estimated yearly use - $.6 \times 10^9$ BTU/yr.

Current status - Well completed. Experiment designed to confirm applicability of single well for both extracting and injecting geothermal fluid. Awaiting final building design to set parameters of experiment.

Bob Tuttle Aquaculture, Fort Rock, OR.

Experimental Aquaculture - Catfish.

Estimated yearly use - 4×10^9 BTU/yr.

Current status - Water has been sampled and test fish grown in the water. Suggested pond sizes and design and roughly estimated costs. Owner currently investigating market and economic factors.

Oregon Trail Development Co., Vale, OR.

Large mushroom growing complex, using downhole heat exchange as heat source.

Estimated yearly use - 12×10^9 BTU/yr.

Current status - System preliminary design completed, final design awaiting well completion. Considerable difficulty experienced in locating small well drilling equipment able to cope with expected temperatures and associated flashing problems. Large rigs are not required for such shallow (300-500 ft) depths and are much more expensive than small rigs.

Coca Cola Plant, Klamath Falls, OR.

Corrosion problem in existing geothermal application.

Current status - Completed - New heating system installed and operating satisfactorily.

Kingswood Apartments, Klamath Falls, OR.

Corrosion problem in existing geothermal application.

Current status - Corrosion analysis by Radian Corp. completed.

Water analysis by Battelle N.W. complete. Fan coil manufacturers able to provide recommended coils being contacted by owners.

Oregon Institute of Technology, Klamath Falls, OR.

Corrosion problems in existing geothermal application.

Current status - Testing of water, sampling methods, corrosion rate measuring equipment, materials, and plate heat exchanger operation continuing. This project is expected to continue for

at least another four months, perhaps more. The Technical Assistance program has minimal involvement, most of the work being done by Battelle N.W. and being coordinated by Paul Lienau under the Geo-Heat Center contract.

Timberline Lodge near Portland, OR.

Feasibility and preliminary design of conversion of existing oil fired system to geothermal. Personal service agreement with James Leshuk, consulting engineer, for engineering analysis. Technical Assistance program will provide economic analysis.

Estimated yearly use - 47×10^9 BTU/yr.

Current status - Work progressing. Engineering analysis is due approximately October 15.

Oakridge, OR.

Richard Bowen and Associates have requested assistance in feasibility analysis of district heating system for the city and some commercial operations, mostly lumber associated processes, utilizing a known but not evaluated geothermal resource in and near the city. Bowen and Associates are providing reservoir data and heat load information. The Technical Assistance program will provide assistance in the system design and economic analysis.

Estimated yearly use - Unknown.

Current status - Reservoir information is being compiled. Work is just starting on heat load determination.

Western Water Wells Project - Greenhouses, Burns, OR.

The company proposes to construct a large greenhouse complex.

Estimated yearly use - Unknown.

Current status - Technical Assistance personnel visited the site and temperature profiled two wells - maximum temperature 104°C from artesian well.

Battelle N.W. has analyzed water samples taken and projects temperature of about 117°C available. The company has engaged a geological consulting firm for geophysical data and that work is nearly complete. As more information becomes available the Technical Assistance program will begin preliminary engineering design and analysis.

PRC Toups Project - Greenhouse, Harney Lake, OR.

The company requested information on greenhouse design and operation and geological data on the area. Information was sent and qualified geophysical consultants referred.

Current status - Economic and marketing analysis was conducted by PRC Toups and found encouraging. Negotiations are under way with geophysical consultants to perform the required work.

Schooler Apartments, Klamath Falls, OR.

Preliminary design and economic analysis of 50 unit apartment complex.

Estimated yearly use - 4×10^9 BTU/yr.

Current status - Technical Assistance report completed, owner put in contact with several qualified engineering consultants. Discussed proposed plans with one of the consultants. Owner presently considering the economics vs. capital cost problems and investigating funding.

Jones Furniture, Klamath Falls, OR.

Preliminary design of scheme to heat small furniture store and adjacent car wash utilizing waste hot water in storm sewer.

Estimated yearly use - 2.1×10^9 BTU/yr.

Current status - Technical Assistance report completed. Owner is currently evaluating the reliability of the heat source and investigating use permit from the city.

Kingsley Field, Klamath Falls, OR.

A request for an initial investigation into the feasibility of providing geothermal space heat to the U.S. Air Force facility. Even though the base is scheduled for closure the Air Force personnel felt that such information would be useful in planning future uses of the facility.

Current status - Completed. Well logs and temperatures and geological information was gathered for the areas surrounding the base. The most promising site selected and rough estimates of well, transmission line and distribution costs made. If the base space facilities could be about 1/2 utilized the plan appears economically feasible.

Henley Area Committee.

Assistance has been requested in planning for zoning and land use and conservation required by new state statutes. Several maps have been prepared, reports written and others reviewed and 5 meetings attended. The area has good prospects for geothermal commercial applications and is currently in agriculture use with high demand for residential use being felt. Resolution of the resulting problems will take considerable time and effort.

CALIFORNIA:

Rose Valley Ranch, Dunsmuir, CA.

Request was for assistance in determining if 450 shaft horsepower could be obtained using 100°F temperature water. Power to be used to supply irrigation water.

Current status - Literature and manufacturer's literature was searched and two companies located who could supply low temperature vapor engines. On analysis of the systems it was determined that for the pumping depth required the machines would supply nearly enough power to pump water to themselves with nothing left to supply irrigation power.

It is interesting to note that had the 100°F water been available at the surface considerable shaft horsepower could have been provided, although perhaps not economically at present electrical energy costs.

Verdant Vales School, Middletown, CA.

Requested assistance in design of a system to provide space heat for swimming pool heat, domestic hot water for greenhouse heat. Source is bleed steam from one of the wells supplying steam for generation of electricity in The Geysers complex.

Estimated yearly use - 7×10^9 BTU/yr.

Current status - Report completed. Design utilizes steam to generate electricity for present electric space heating installation. Condensate to supply domestic water, swimming pool and greenhouse heating. Owners are currently negotiating agreements concerning generation and possibility of feeding excess power back to P.G.E.

Ft. Bidwell Indian Reservation, Ft. Bidwell, CA.

Assistance was requested in finding a suitable application to utilize an existing developed spring with temperature of approximately 90°F. The application should be adaptable to the indian population and be labor intensive to provide local employment.

Current status - The site was visited and discussions held with tribal administrator and a planning consultant retained by the tribe. Water sample was returned to OIT and 2 generations of guppies raised in it to test suitability of aquaculture direct use. The site is nearly perfect for gravity fed ponds or greenhouse heating system. Aquaculture was suggested since abundant fish food exists in adjacent lakes and would provide more employment and support the aquaculture project. It does not appear feasible to provide space heat since the density is very low. The above was reported and we are waiting for further feedback from tribal leaders.

City of Susanville, Susanville, CA.

Request is for assistance in the form of seminars for local well drillers, plumbers, heating contractors, etc. who might be involved in the construction and maintenance of the district heating system being planned.

Current status - The date for the first seminar, well drilling, has been set in October and planning of the seminar has begun. Others will follow as the heating system project progresses.

Basic Foods, Vacaville, CA.

The company has requested assistance in locating a suitable site for a food dehydration plant and continuing updating on improved designs and

equipment that might be used in the plant. Company officials foresee either a relocation or new plant within several years.

Current status - Information about possible available sites is being forwarded to the company as they are discovered.

ARIZONA:

IBM, Tucson, AZ.

IBM has requested assistance in the design and analysis of a system to provide 500 ton of refrigeration for cooling their industrial spaces. The resource is 300°F water from wells to be drilled on site. Water of that temperature is available near the site and assumed to also be available on site.

Estimated yearly use - Unknown. Since the total use of the resource could probably include space and process heating as well as cooling.

Current status - A short report has been submitted in which a system to generate electricity is described - the electricity to provide power for conventional compression cooling. This initial plan was proposed since: 1. no commercially available absorption units of sufficient size and reasonable economy could be located, 2. this system would provide the most flexible system providing small cooling units in locations specifically requiring cooling, 3. the system would provide electrical power during periods when cooling is not needed and 4. the system would be more reliable and would provide cooling during geothermal system shutdown by using the conventional power.

Further work is awaiting comments from IBM.

Three more requests for assistance have been received from Arizona:

1. cooling and heating the state penitentiary
2. cooling and heating a hospital
3. heating and cooling a large greenhouse

These were scheduled for investigation early this fall but according to Richard Hahman, Arizona Department of Geology & Minerals, U. S. DOE, decisions to stress solar energy rather than geothermal have resulted in non-funding of projects to locate and evaluate geothermal resources in Arizona. Recent conversations with Mr. Hahman indicate that this will delay the Arizona geothermal program at least one and possibly two or more years.

NEVADA:

City of Reno Moana Swimming Pool heating, Reno, NV.

Assistance was requested in investigating the feasibility of geothermally heating the swimming pool located just outside the known hot water area in southwest Reno. The Technical Assistance program study based on obtaining 160°F water indicated excellent economics and the project pursued by the city. A test well was drilled and a hydrologist retained to analyze data from the test well and other wells nearby.

Estimated yearly use - 8.2×10^9 BTU/yr.

Current status - The test well was recently completed and temperatures of only 120°F obtained at 500 ft. Geological and cuttings evidence indicated that hotter water would not be obtained at greater depths. A redesign and evaluation of the project utilizing the lower temperature water is planned for late fall after temperature reductions in the existing system can be tested to determine their effects.

The Newlands Green Valley Estates, Fernley, NV.
Geo-Products Inc.

Assistance in the preliminary design and economic analysis of a district heating system for 752 homes, a part of a planned development of 7,000 homes, shopping and recreational center, and approximately 1800 acres of industrial complexes.

Estimated yearly use - 899.8×10^9 BTU/yr.

Current status - A report has been completed and submitted to the owners. Geological work was completed by a consulting geological firm. Presently the Earl Warren Legal Institute is providing some assistance in obtaining the necessary permitting to allow formation of a heating utility. It is reported that several industries are interested in the industrial site area.

Las Vegas Hilton Hotel, Las Vegas, NV.

The Las Vegas Hilton engineering staff requested assistance in evaluating a proposed scheme to supply geothermally heated domestic hot water for the hotel. Suggestions concerning the design were made and an economic analysis made. Based on these results Hilton staff did a computer simulation of heat loads and an economic analysis. Favorable results led to retaining a consulting geological firm to investigate the resource, and a consulting engineering firm to provide more detailed engineering designs.

Estimated yearly use - 7.5×10^9 BTU/yr for domestic water. Swimming pool heating and the possibility of cooling would approximately triple the yearly use.

Current status - The consulting engineering firm has not completed their work. Information about geothermal cooling has been forwarded to the firm. Technical Assistance staff have been asked to consult and review the proposed design.

Note: The Hilton staff would prefer not to have any publicity on this until the feasibility is clearly known and plans for actual retrofit are underway.

City of Caliente, Caliente, NV.

Dave Chambers, LBL, requested assistance for the city in the investigation of a possible heating district for the city. A meeting in Caliente resulted in good response from townspeople and the site was inspected.

Expected yearly use - unknown.

Current status - Preliminary information about the town, weather, maps, aerial photos, energy consumption, etc. are being gathered by city personnel. When these are received a preliminary design will be done and economic analysis made. Geological data on the area is badly needed.

Grover C. Dils Medical Center, Caliente, NV.

Requested assistance in retrofit of small hospital to utilize geothermal water of 120°-150°F.

Estimated yearly use - $.8 \times 10^9$ BTU/yr.

Current status - Preliminary design and economic analysis completed.

Well to be drilled in near future. Final recommendations awaiting results of drilling.

Moapa Indian Reservation, Las Vegas, NV.

Assistance was requested to investigate the possibility of utilizing existing springs some distance from the existing greenhouse complex. A report was submitted indicating the plan was not feasible due to long transmission distance and recommended geological investigation to attempt to

locate a nearby resource. A consulting geology firm was retained and the study should be completed shortly.

Estimated yearly use - 71×10^9 BTU/yr.

Current status - Awaiting geological report and contact from indian representatives.

Public Information.

The display depicting "on line" direct low temperature applications has been shown at 6 sites from California to Virginia.

Much of the public information work is in conjunction with the Geo-Heat Utilization Center and no attempt is made to keep separate accounting of information packets, speaking engagements, etc. A copy of the final report of the Geo-Heat Quarterly Bulletin is included to eliminate duplication of that information. Complete information is available from the three quarterly and the final reports.

Additional Work.

A great deal of work not reported above as specific projects has been accomplished during "spare time".

Nomographs and charts on space heating vs. design temperature and area, piping costs, cooling loads, heating capacity of various devices vs. temperature, etc. have been developed for in-house use in project work. No attempt has been made to make these extremely accurate and they are not suitable for publication, but knowing their derivation and shortcoming, they are valuable time savers.

Programs for the TI 59 hand-held calculators have been developed to compute well and casing information, heat losses in buried insulated pipe, heat losses in bare pipe in air, and pressure losses in piping.

Manufacturer's information on equipment and devices is gathered and will soon be cataloged.

The library is being cataloged with some 400 titles and 500 volumes completed. This task is about 70% completed.

Answering questions via telephone continues to be a major function. These range from inquiries about pumps, heating units, geology, etc. to rather technical descriptions of systems, corrosion problems and possible solutions, etc. We estimate between 5 and 10% of the time is spent on this service.

Requests to present papers, serve on technical committees, etc. are increasing and if the trend continues will require about one-tenth or more man year. Preparation of a good paper in a rapidly expanding field requires considerable time and some technical committee work requiring considerable research.