**GeothermEx, Inc.**
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## DRILLING SERVICES

GeothermEx provides a complete range of services for geothermal well design and drilling operations, including:

- well-site selection
- well design
- design of civil works (well pads, sumps, roads, etc.)
- preparation of drilling specifications
- preparation of bid documents
- contractor and sub-contractor selection
- permitting and environmental clearances
- budget planning and cost control
- management of operations
- 24-hour on-site supervision of drilling
- design and supervision of logging programs
- design and management of well-test operations
- on-site well-test operations
- well completion and site clean-up
- remedial activities, including well clean-outs, workovers and abandonments

Our drilling experience has included high-temperature (to 360°C or 680°F) and low-temperature systems, steam-dominated, two-phase, single-phase and hypersaline systems, and has varied from consultation to the complete management of all aspects of drilling, logging and testing. Work has ranged from single wells to complete field development, and from straight holes to multiple-leg completions from a single wellhead, to multiple deviated wells from a single pad. We drill with foam, mud, water and air, to depths as great as 3,500 m. Cumulatively, GeothermEx has drilled some 500,000 feet (150,000 m) of exploration, production and injection wells. Some examples are given below, representing widely differing conditions and objectives.

- Western GeoPower: The Geysers geothermal field, California. Data analysis on previous field production, assessment of current field capacity and future pressure decline. Determination of the number of wells needed for a 35 MW power plant. Assistance with permitting issues and economic pro-forma estimates. Well design and drilling budget estimation. Assistance with procurement of drilling services and materials. Drilling engineering and wellsite geology during well drilling phases. Well testing and reservoir engineering. 2007-present.

- SOGEO (Sociedade Geotérmica dos Açores): Ribeira Grande geothermal field, São Miguel, Azores. Selection of drill sites, well design, selection of drilling contractor, management of contracting and supervision of drilling, logging and testing of two new production wells at an established geothermal field. Preparation of reports documenting drilling procedures and results. 1998-present.

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- Akita Geothermal Energy Company, Ltd.: Uenotai, Japan. Design of drilling and workover programs; procurement of specialized equipment and materials; control of well blow-out and $H_2S$ discharges; preparation of training manuals; on-site guidance of Japanese drilling engineers. Completed five wells to average depth exceeding 7,000 feet (2,200 m) and supervised several workovers. 1988-2003.

- INDE (Instituto Nacional de Electrificación): Zunil geothermal field, Guatemala. Well site selection, well design, selection of drilling contractor, monitoring and recommendations during drilling operations, for two injection wells at a new geothermal development where GeothermEx previously provided geological and well testing services for production wells. Oversight of ongoing drilling activities on behalf of the project financiers. 1998-2000.

- Geothermal Energy Partners, Ltd.: The Geysers geothermal field, California. Management of all aspects of drilling, logging and testing, including permitting, well design, preparation of drilling specifications and tender documents, contracting of driller and other suppliers, on-site supervision of drilling, management of budget, supervision of subcontractors, geologic and geochemical logging, design and implementation of well-test and chemical sampling programs. Directional drilling, air drilling and drilling of multiple-leg (or "forked") wells in a high-temperature, high-gas region of the field. Preparation of all reports. Three new production wells, four forked wells and three injection well workovers. Well depths to 11,500 feet (3,500 m). 1992-1997.

- Brady Power Partners: Bradys Hot Springs, Nevada. Selection of drill sites after detailed geologic modeling. Design of drilling programs, including logging and testing, for 16 production and injection wells and six slim holes with depths of 650 to 3,000 feet (200 to 900 m). Field monitoring of drilling operations. Flow testing, fluid sampling, injection testing and chemical tracer testing. Preparation of reports. Selection of sites for additional wells. 1991-1992.

- Ormat, Inc.: Empire (San Emidio Desert), Nevada. Selection of well sites and design of production and injection wells and slim holes from 350 to 2,000 feet (100 to 600 m) depth. Supervision of drilling and logging. Wellsite geology and flow testing. Preparation of reports. 1987-1988.

- Barnwell Industries: Puna Rift, Hawaii. Selection of drill sites after detailed evaluation of exploration data. Design of drilling programs, including logging and testing for three holes 4,000 to 8,000 feet (1,200 to 2,400 m) depth. Permitting and environmental clearances. Wellsite geology and geochemistry. Management and on-site conduct of logging and testing operations. Management of environmental monitoring. Preparation of all reports. 1980-1984.

- Instituto Costarricense de Electricidad: Miravalles, Costa Rica. Selection of drill sites after detailed evaluation of all exploration data. Design of well depth and casing program; design

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of logging and testing program. Management of drilling program; on-site drilling supervision. Supervision of wellsite geology, including geophysical logging, fluid geochemistry and temperature logging. Design of well-test program, for 14 wells of average 5,000 feet (1,500 m) depth. Preparation of all reports. Selection of sites for additional wells. 1979-81; 1983-1984; 1995-2005.

- Banca Serfin: Cerro Prieto, Mexico. Management of purchasing of supplies and equipment; on-site supervision of drilling and well-test operations; test-data analysis and reserves calculations; budget management. Over a dozen wells, to average depth of 7,000 feet (over 2,000 m). 1993-1995.

- Los Angeles Department of Water and Power: Coso Hot Springs, California. Selection of drilling sites after detailed evaluation of exploration data. Design of drilling, casing, logging and testing programs. Preparation of drilling specifications and tender documents; selection of drilling contractor and miscellaneous sub-contractors. Management of environmental program and site restoration. Management and on-site supervision of drilling, logging and testing programs. Budget management. Three wells averaging 4,300 feet (1,300 m) in depth. Preparation of all reports. Selection of sites for second round of drilling. 1981-1987.

- Kennecott Corporation: Lihir Island, Papua New Guinea. Design of drilling, logging and testing program. On-site supervision of drilling, geological and geophysical logging, and injection and flow testing. Chemical monitoring and analysis. Analysis of well-test data. Preparation of field models. Preparation of reports. Several dozen slim holes to 1,300 feet (400 m) depth. 1987-1990.

- CEL (national electric utility of El Salvador): Chipilapa, El Salvador. Design of directional well; management of drilling and logging operations; on-site supervision of drilling; budget and cost control; interpretation of results. Well depth 8,500 feet (2,600 m). 1992.

- Ormat, Inc.: Steamboat Springs Nevada. Selection of well sites and design of several production and injection wells to average 600 feet (200 m) in depth. On-site supervision of drilling, geologic and temperature logging and flow and injection testing. Monitoring of production conditions. Monitoring of fluid chemistry. Interpretation of results. Preparation of reports. 1985-1986.

- OreIda Foods, Inc.: Ontario, Idaho. Selection of drilling sites after detailed evaluation of exploration data. Design of drilling, casing, logging and testing programs for 10,000 foot (3,050 m) hole. Selection of drilling contractor and all sub-contractors. On-site management of drilling, geologic, geochemical and geophysical logging and flow testing programs. Preparation of all reports. 1978-1979.

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- Northern California Power Agency: The Geysers, California. Selection of drill sites after detailed review of exploration data. Design of drilling, casing, logging and testing programs. Preparation of specifications and tender documents. Permitting and regulatory reporting. Management of geological and geophysical logging, geochemical sampling, and well-testing operations for 24 deviated wells, average depth 6,000 feet (1,800 m). Interpretation of logs and well-test results. Preparation of all reports. 1981-1983.

- Hunt Energy Company: Cove Fort, Utah and Las Cruces, New Mexico. Participation in selection of drilling sites. Design of wells. Selection of drilling contractor. Budget design and cost control. On-site management of drilling and logging, for holes of average 3,300 foot (1,000 m) depth. Preparation of final report. 1977-1979.

- Carson Development Corporation: Litchfield and Wendel, California. Site selection, well design, and management of logging and testing program for 2 production wells to average 1,400 feet (400 m) depth. Preparation of all reports. 1980-1981.

- City of Susanville: Susanville (California). Site selection, design, selection of drilling contractor, on-site supervision of drilling, logging and testing of 1 production well to 1,500 foot (450 m) depth. Preparation of all reports. 1980-1981.

- Sunoco Energy Development Co.: Seven wells in geothermal areas in Idaho, Nevada and California, averaging 6,500 feet (2,000 m) in depth. Selection of drilling sites after detailed review of all geoscience data. Wellsite geology, including geochemistry of thermal fluids; supervision of borehole geophysical logging. Design and management of well tests; analysis of well-test data. Preparation of interim and final reports. 1977-1980.

In addition, GeothermEx has drilled and logged more than 300 temperature-gradient slim holes in the United States, the Philippines, Costa Rica, Indonesia and elsewhere to depths of 50 to 1,000 m, for a cumulative total depth of about 325,000 feet (100,000 m), during the years 1975-1989. This work has involved:

- analysis of exploration data
- drillsite selection
- permitting
- environmental mitigation
- on-site management of drilling and logging
- data analysis and interpretation
- reporting and site clean-up.

Rigs have included continuous coring (diamond bit), air hammer, rotary (tri-cone bit) and cable tool (hammer). Environments have included young volcanic terrain, sedimentary basins, granitic plutons, and metamorphic terrain. Temperatures have exceeded 200°C (400°F) in many areas.

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GeothermEx has also prepared drilling specifications for projects offered for bid to others by the World Bank and US AID in Djibouti, St. Lucia, the Philippines and Kenya; and for projects operated by private parties in Japan, Portugal (the Azores), and the United States. GeothermEx has provided on-site evaluation of drilling activities and expenditures on behalf of financing organizations in Mexico, Bolivia, and United States; and has provided remedial services for wells drilled and equipped by various parties in China (Tibet), El Salvador, Japan, the United States and Hungary.

GeothermEx provides its own drilling engineers, drilling superintendents, well-site geologists, well-test engineers and project managers, as well as purchasing and contracting specialists, accounts clerks and related support staff. We provide computer-designed casing-strength programs, geochemical scale-forecast, injection-tracer design and monitoring, and chemical monitoring of well performance, among other services. We have performed well-site geology, temperature/pressure logging, and geochemical logging at more 40 fields in numerous countries around the world.