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Geothermal Development and Outreach in Utah – 2006

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ABSTRACT

Geothermal development continued in Utah during 2005 at a somewhat increased pace due to higher energy prices and government incentives. Geothermal power operators announced expansion or reconstruction plans for the two premier geothermal areas in the state – Roosevelt Hot Springs and Cove Fort-Sulphurdale. Expansion of greenhouse space continues at the Newcastle area in southwestern Utah, and at the Crystal-Bluffdale area near Salt Lake City. A proposed project may use low-temperature geothermal energy to provide space heat for a large public transit service center in Salt Lake City. A consortium of research institutions has begun to formulate plans to investigate the broader potential of the Roosevelt-Cove Fort geothermal district. Heightened interest in geothermal energy was reflected in the significant public participation in workshops and working group meetings over the past year. Several new publications are also available, along with other information, through the Utah Geological Survey's geothermal website.

Introduction

Interest in geothermal resource development has increased in Utah within the past year as a result of various economic factors and government incentives. The rise in energy prices has led to new realization of the economic benefits of renewable energy. In addition, the federal Energy Policy Act of 2005 (EPACT) created new incentives for development. EPACT provides for a production tax credit for geothermal-generated electricity placed on-line before January 1, 2008. EPACT also mandates new rules for federal leasing for both geothermal electrical generation and direct-use – provisions that will have implications long into the future. Possibly as a result of these incentives, we are seeing a resurgence of interest in geothermal projects for both electrical generation and for heating as entities attempt to use geothermal energy to offset the high prices of fossil fuels. This paper summarizes projects, events, and initiatives related to geothermal developments that have recently taken place in Utah (Figure 1).

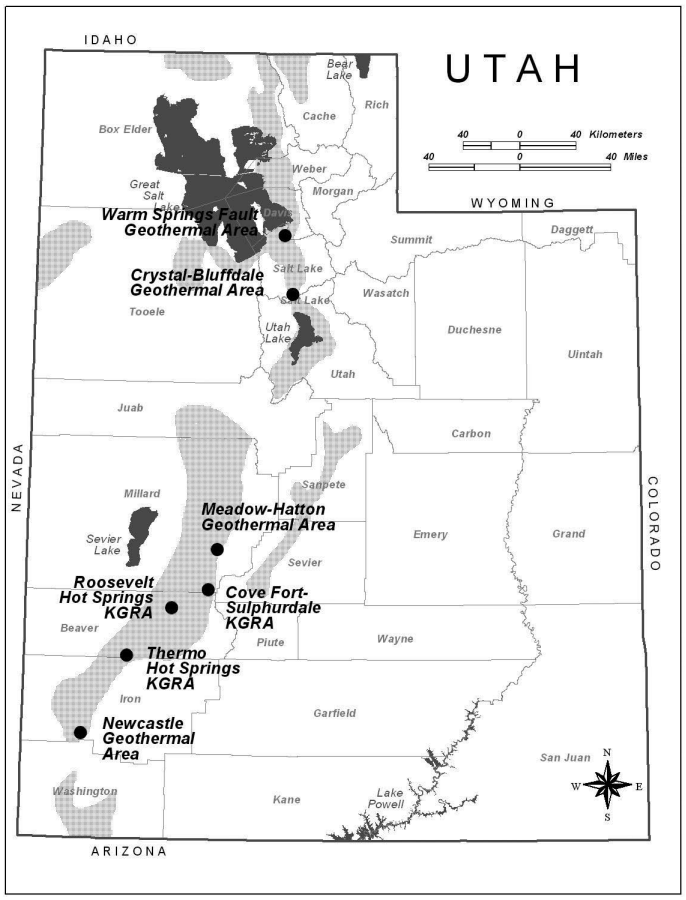

Figure 1. Areas discussed in the text. Light shaded regions denote potential geothermal resources.

Activity Summary

Cove Fort-Sulphurdale Geothermal Power Project

The Cove Fort-Sulphurdale Known Geothermal Resource Area (KGRA) lies on the northwest side of the Tushar Mountains in northeast Beaver County and southeast Millard County, and is roughly 32 km (20 mi) north along Interstate Highway 15 from the town of Beaver. The geothermal system results from a combination of complex geologic structures that localize the resource. Prior to 2003, the Utah Municipal Power Agency (UMPA) operated four binary-cycle power units with a combined capacity of 3 megawatts (MW), a turbine generator (2 MW) placed upstream from the binary units, and a condensing turbine rated at 8.5 MW. UMPA operated the facility known as Cove Fort Station No. 1 on behalf of the City of Provo. Dry steam at about 150°C (300°F) is in relatively shallow (183 to 396 m [600 to 1300 ft] deep) fractured Paleozoic sandstone (Ross and Moore, 1985). One well was completed into the deeper system and produced geothermal fluid for the condensing turbine.

Draper, Utah-based Amp Resources purchased the UMPA-Provo power facility, also known as the Bonnett plant, at the Cove Fort-Sulphurdale KGRA in 2003. Amp closed the facility in anticipation of dismantling the existing power station and then building a new power plant based on Kalina-cycle technology.

On December 6, 2005, Amp announced that it had signed a 20-year power purchase agreement with PacifiCorp for the output of a new geothermal electric generating station to be built at the old site. Amp plans for a generating capacity from 37 to 42 MW with the new station. The Cove Fort project was selected as part of PacifiCorp's Request for Proposals 2003-B, to acquire up to 1100 MW of cost-effective, renewable resources. In response to the request, PacifiCorp received more than 50 bids for some 6000 MW of renewable energy projects including wind, geothermal, hydro, solar, and biomass (Amp Resources, 2005).

At the time of this writing, Raser Technologies, Inc. was in the process of acquiring Amp Resources (Amp Resources, 2006).

PacifiCorp Blundell Expansion

The Roosevelt Hot Springs geothermal area is situated on the west flank of the Mineral Range in Beaver County, roughly 16 km (10 mi) northwest of the town of Milford (Figure 1). It is the most studied geothermal system in Utah. The system is associated with relatively young igneous activity, expressed as Quaternary rhyolite domes within the Mineral Range, combined with recent Basin and Range faulting, an older east-west fault system, and a still older system of near-vertical faults associated with a low-angle detachment zone (Mabey and Budding, 1987).

Utah Power has operated the Blundell Geothermal Plant since 1984, using steam from the Roosevelt Hot Springs geothermal field to power the single-flash plant. The steam is separated from hot, pressurized brine at temperatures over 260°C (500°F) from four production wells. The hot brine is returned to the reservoir at temperatures approaching 177°C (350°F) through three injection wells (Steve Austin, Intermountain Geothermal, verbal communication, May, 2005). PacifiCorp, the parent company of Utah Power, announced on April 11, 2006, that it plans to expand the 26-MW (23 MW net) Blundell geothermal plant in Beaver County, Utah, to generate an additional 11 megawatts of electrical power (Deseret News, 2006).

Ormat Nevada, Inc. will provide an 11-MW (10 MW net) Ormat Energy Converter (OEC) binary power unit that will extract heat from the hot brine to generate the additional power. Ormat, Nevada Inc., a subsidiary of Ormat Technologies, Inc., signed an $11.5 million contract to deliver the OEC in the second quarter of 2007 (Ormat, 2006). PacifiCorp Energy entered into a $19 million contract with CEntry Constructors & Engineers of Salt Lake City for engineering and construction of the project. The new OEC unit is expected to start producing power on November 1, 2007 (Deseret News, 2006).

PacifiCorp Energy generates electricity and manages energy trading and coal mining for PacifiCorp, now a subsidiary of MidAmerican Energy Holdings Company (MEHC), serving 1.6 million customers in Utah, Oregon, Washington, Idaho, California and Wyoming. MEHC completed purchase of PacifiCorp March 21, 2006 from Glasgow-based ScottishPower. Intermountain Geothermal, the field operator at Roosevelt Hot Springs, is a subsidiary of MEHC.

Newcastle Geothermal Greenhouses

Geothermal greenhouse businesses at the Newcastle geothermal area in Iron County continue to operate successfully (Allred, 2004). Newcastle is a small, unincorporated community surrounded by farms in the sparsely populated Escalante Valley, about 48 km (30 miles) west of Cedar City in southwestern Utah (Figure 1). Greenhouse use of geothermal water began after discovery of the resource in 1975. Milgro, a private commercial greenhouse operator, became established at Newcastle in 1993 with construction of a 46,450 m^2 (500,000 ft^2) greenhouse complex devoted mostly to the production of potted chrysanthemums. Subsequent additions brought Milgro's total greenhouse space at Newcastle to 102,200 m^2 (1.1 million ft^2). Milgro's primary greenhouse operation, located in southern California, has 204,400 m^2 (2.2 million ft^2) of capacity. Milgro is now the nation's largest producer of chrysanthemums, delivering 30 million cuttings to other growers each year.

Also at Newcastle, Castle Valley Greenhouses recently completed a 4600-m^2 (49,500-ft^2) addition of geothermal-heated greenhouse space for a total of 8360 m^2 (90,000 ft^2). Castle Valley raises several varieties of tomatoes for local and regional markets.

There are many uncertainties associated with the Newcastle geothermal resource. There are no surface geothermal manifestations. The source of geothermal fluid is probably a zone of up-flow associated with the range-bounding Antelope Range fault, a Quaternary-age feature located less than a mile to the southeast from the main production area. From there, geothermal fluid spills into the Escalante Valley aquifer, forming a broad outflow plume with temperatures about 93°C (200°F)

in the shallow subsurface (Blackett and Shubat, 1992). The Utah Geological Survey (UGS) continues to monitor several temperature-gradient boreholes in the area for changes to the thermal regime of the system (Blackett and others, 1997). Over the past few years, temperature changes with time observed in the thermal profiles may be the result of geothermal production, prolonged regional drought, ground-water withdrawals from the main Escalante Valley aquifer to the west, or a combination of all these factors.

Crystal Hot Springs, Utah State Prison Geothermal Heating Project

The Crystal (Bluffdale) Hot Springs geothermal area is located at the south end of the Salt Lake Valley, about 3.2 km (2 mi) north of the Traverse Mountains and the feature called "Point of the Mountain" near the Utah State Prison (Figure 1). Klauk and Darling (1984) reported that surface spring temperatures vary between 55° and 84°C (131° and 183°F). Subsurface temperatures of 85°C+ (185°F+) have been reported in production wells ranging from about 183 to 305 m (600 to 1000 ft) in depth. A total of three production wells are currently available for both geothermal greenhouses operating in the area, and the prison project (see Bluffdale Flowers discussion below). One well is owned by the Utah Department of Corrections (UDC) and dedicated to the prison heating system, the other two are owned by Bluffdale Flowers. A fourth well owned by the prison was recently re-discovered and may be available for use in the near future. The springs normally issue from valley alluvium into several ponds. When production wells are in operation, the surface springs and ponds reportedly dry up.

The geothermal heating system for the Utah State Prison came back on line in January 2004, after being shut down for most of the past 20 years, mainly due to calcite scaling. Johnson Controls, Inc., an energy-service company, entered into a long-term agreement with the UDC to provide heat to the minimum-security wing of the prison. For Phase I of the project, Johnson Controls re-engineered and rebuilt the heating system to eliminate the past scaling problems, and provide space and water heating to about 3720 m^2 (40,000 ft^2) of the complex. In Phase II, Johnson completed additions to the Prison project in the fall of 2005, and the geothermal heating system currently supplies heat and domestic hot water for 30,906 m^2 (332,665 ft^2) of the prison (including five large buildings housing 1460 inmates beds). The spent geothermal fluid is cooled and cascaded to an aquaculture facility (tropical fish rearing) located about 0.8 km (0.5 mi) to the west and operated by Hi-Tech Fisheries. The prison expects to save up to $344,000 in natural gas prices in the next fiscal year.

Crystal Hot Springs, Bluffdale Flowers Greenhouse Expansion

Bluffdale Flowers, also located in the Crystal Hot Springs geothermal area in southern Salt Lake County and known as Utah Roses prior to 1998, operates a 23,225-m^2 (250,000-ft^2) geothermal-heated greenhouse complex producing 40 varieties of cut roses and other flowers. The complex has operated successfully at the site since its establishment in 1981. The facility uses two wells (183 and 274 m [600 and 900 ft] deep) to supply geothermal water at a temperature of about 85°C (185°F) to a surface heat exchanger, which is coupled to a closed loop fluid/heat distribution system serving the greenhouses. This distribution system is old, highly inefficient, and contributes to production problems during cold periods. Bluffdale Flowers plans an expansion of an additional 9290 m^2 (100,000 ft^2) of greenhouse space if the geothermal system can be effectively upgraded and extended into the new facility.

Through the U.S. Department of Energy's (DOE) GeoPowering the West (GPW) initiative, the Utah Geothermal Working Group (UGWG) has proposed that the Oregon Institute of Technology (OIT) Geo-Heat Center determine the feasibility and cost effectiveness of retrofitting Bluffdale Flowers' existing greenhouse complex with a new geothermal heat distribution system. The feasibility study will help determine appropriate upgrades to the heating system without increasing geothermal flow from production wells.

The primary benefit of this project will be improvement in the efficiency of the geothermal heating system for the existing greenhouses and possibly allow expansion of the business. This will, hopefully, be done without the expense of drilling new production wells, and without added stress on the geothermal system, thereby conserving the resource. Three businesses (Bluffdale Flowers, Steve Davis Aquaculture, and Hi-Tech Fisheries), and UDC use the geothermal resource at Crystal Hot Springs for space heating and aquaculture. Since all users tap the same resource, it is vital that the most efficient system designs be employed to maintain the resource.

UTA Warm Springs Service Center Proposed Geothermal Space Heating

The Warm Springs fault geothermal area extends about 4.8 km (3 mi) in length and 1.2 km (0.75 mi) in width, lying along the base of the Wasatch Range, just north of Salt Lake City. Beck's Hot Spring, Wasatch Warm Springs, Hobo Warm Springs, and Clark Warm Springs occur along a segment of the Wasatch fault. Discharge temperatures in this system range from 27°C (81° F) Clark Warm Springs, to 55°C (131°F) at Beck's Hot Spring (Klauk and Darling, 1984).

Also through the GPW program, the UGWG recommended a study to determine the feasibility of geothermal space heating at a large maintenance facility near Wasatch Warm Springs in Salt Lake City. The Utah Transit Authority (UTA), a quasi-government agency providing mass transportation for the densely populated Wasatch Front of northern Utah, acquired the facility, known as the Warm Springs Service Center, in 2003. The Service Center is part of a planned commuter rail system that will service a 161+ km (100+ mi) long corridor along the Wasatch Front.

Geothermal springs in the area are known, but have not been recently utilized. Lutz (2004) described the first use of the springs for therapeutic bathing, by Mormon settlers, beginning about 1850. The area experienced several periods of

recreation and balneological development, each followed by economic collapse or some catastrophe. The most recent effort to use the resource began following a 1984 study by the OIT Geo-Heat Center to establish a geothermal heating system for the Children's Museum of Utah (Karlsson, 1984). Lutz (2004) reported that the hot water was still used to heat the museum building, which originally housed a swimming pool.

The proposed project will provide information needed by UTA to determine the feasibility of installing supplemental geo-heat systems at the Warm Springs Service Center. UTA acquired the Warm Springs Service Center building for commuter train maintenance. The total inside area of the building is 15,330 m^2 (165,000 ft^2), of which 11,150 m^2 (120,000 ft^2) will require heat. The Warm Springs Service Center was billed for 80,693 thermal units costing a total of $81,916 between December 30, 2005, to March 16, 2006, and the building was not occupied.

Intermountain West Geothermal Consortium Utah Focus Area

EPACT authorized establishment of the Intermountain West Geothermal Consortium (IWGC). The act designated management of the IWGC to Boise State University with the University of Idaho, the Idaho National Laboratory, the Energy & Geoscience Institute, the Desert Research Institute, and OIT composing the members. The IWGC's mission is to support national energy security through research and development of under-utilized geothermal resources in the Intermountain region. Its focus is to incorporate emerging geological, geochemical, and geophysical techniques with new data, and apply these studies to high-potential regions in the Intermountain West.

For Utah, the IWGC will focus an investigative effort on the large geothermal "quadrangle" in central and southwest Utah that includes the Cove Fort-Sulphurdale KGRA on the east, the Roosevelt Hot Springs KGRA on the west, the Meadow-Hatton area on the north, and the Thermo Hot Springs KGRA on the south. This region is roughly 80 km (50 mi) long and 48 km (30 mi) wide. The overall IWGC goal is to expand the known geothermal resources, provide critical information on resource permeability in order to reduce the risk of drilling dry holes, and enable future exploitation within the district at sites not currently under development (Energy & Geoscience Institute, 2006).

Geologic investigations will be directed at improved understanding of the structural and stratigraphic relationships and their influence on fluid movement at depth. Satellite imagery will help determine relationships among geothermal activity, fluid movement, and fracture distributions. Numerical studies will test conceptual models of basin-scale fluid and heat flow. Geophysical investigations employing 3-D imaging, with new magnetotelluric and other electromagnetic surveying, will be a primary technique to establish fluid and alteration pathways through their influence on electrical resistivity. Study of tritium and carbon-14 will provide information on subsurface fluid temperatures, sources, ages, and movement.

Geopowering the West

Utah Geothermal Working Group Meetings and Workshops

The UGWG is an organization comprised of representatives from federal, state, and local governments; utilities; renewable energy advocates; geothermal industry; environmental organizations; landowners; and other entities interested in development of geothermal energy in Utah. The UGWG's mission is to promote development and effective utilization of Utah's geothermal resources for direct use, power generation, and cascading uses. Since organizing in March 2003, the UGWG has met five times and co-sponsored three workshops. Early meetings were organized to inform participants about federal/state regulatory processes and incentives for geothermal developers. More recently, meetings have focused on reviewing active or proposed geothermal projects – both for direct use and electrical generation. Presentations and summaries of UGWG co-sponsored workshops are accessible at http://geology.utah.gov/emp/geothermal/ugwg/index.htm, and they include:

- January 2004 - "Exploring Utah Geothermal Opportunities: Development and Financing." The workshop focused on geothermal direct-use applications and helped identify barriers to project development and policy option remedies on the state level.
- August 2005 – "Geothermal Power Generation." The workshop was organized in cooperation with GPW and the GPW Utility Working Group, and was designed for utility resource personnel, focusing on key benefits and risks of including geothermal power in a utility's resource portfolio.
- March 2006 – "Ground-Source Heat Pump and Direct-Use Workshop." The UGWG, GPW, OIT Geo-Heat Center, and other organizations, co-sponsored the two-day event that addressed direct-use applications of geothermal resources and ground-source heat pumps.

Utah Geothermal Website

The UGS continues to maintain and develop a website for geothermal resource information in Utah. The site can be accessed at http://geology.utah.gov/emp/geothermal/index.htm. Included are links to documents, maps, and datasets pertaining to geothermal resources in Utah. Also included are regulatory guides, bibliographies, summaries of working group meetings, along with presentations, and links to other geothermal Internet sites.

Future Direction

We recently proposed a two-year continuation to our program primarily to continue the efforts of the UGWG and to assist with the U.S. Geological Survey's (USGS) national geothermal re-assessment. The program will consist of (1) continuing the efforts of the Working Group; (2) gathering additional geothermal information, and assimilating the new data into existing data sets supporting the USGS's initiative; and (3) promoting partnerships through various outreach activities.

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