ELKO COUNTY SCHOOL DISTRICT HEATING SYSTEMS ELKO, NEVADA
- A CASE STUDY -

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LOCATION

The Elko County School District

The district heating system is located in the city of Elko in the southwest portion of Elko County, Nevada. Elko County is located within the Basin and Range Physiographic Province in the southwestern United States (Fenneman, 1931). The Elko County School District system is one of two district heating systems in Elko, with the other being the privately-owned system operated by the Elko Heat Company. In 1985, the school district had originally planned to drill a well to tap low-temperature geothermal resources that could be used for a geothermal heat pump system for the junior high school. However, when the well, drilled to 1,876 ft (572 m) encountered significant flows of 190°F (88°C) geothermal water, a decision was made to serve all of the school district facilities in Elko as well as a number of additional public buildings, including the hospital and Convention Center, through the construction of a district heating system (Figure 1). The School District is at present in the process of determining the feasibility of expanding the system to serve a number of buildings on the Great Basin College Campus (CBC). Preliminary findings indicate that a number of significant changes would have to be made to the existing system in order to meet the heating load requirements of the CBC facilities.

RESOURCE

Elko County is located within the Basin and Range Physiographic Province. The distinctive features of this province are isolated, longitudinal fault-block mountain ranges separated by long, alluvial-filled basins. The city of Elko is located on the floor of one of these basins. The county's geothermal resources are located within the Battle Mountain Heat Flow High, as defined by Sass, et al. (1971).

The area has been defined as a region of high heat flow where 194 to 302°F (90 to 150°C) resources are associated with deep fluid circulation along range front faults (Converse Consultants, 2002). The Elko area has a long history of geothermal water use and development, beginning with Native American use of the water at the "Hot Hole" in

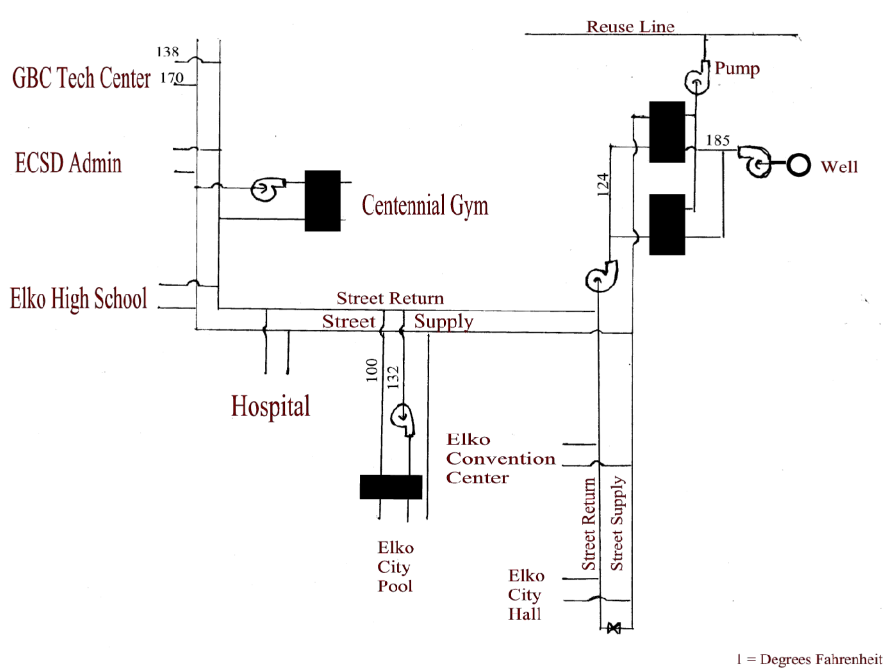

Figure 1. Geothermal system layout.

Elko Junior High School

Elko Convention Center

southwestern Elko. Continued use and reference to the Hot Hole and associated hot water springs was made by pioneers along the Oregon Trail in the 1840s. Development of the hot springs in the area provided for the old "Elko Home for the Aged," and subsequently the Elko County Association for Retarded Children used the area's hot water into the late-1970s (Converse Consultants, 2002). Review of the geologic literature suggests that there may be an extension of a fault or fault zone from the Sulfur Springs hot springs southwest of the city, which travels northwest through the community and intersects the Hot Hole and its associated springs as well as the geothermal high in the area of the Elko Junior High School. A 1,876 ft (572 m) well drilled adjacent to the junior high school in 1985 encountered 300+gpm (18.92+ L/s) of 190ºF (88ºC) water in the bottom 20-30 ft (6-9 m) of the hole. This is the resource currently supplying the Elko County School District heating system.

Several other geothermal wells have been drilled in the Elko area including the Elko Heat Company well which was drilled in 1982 to a depth of 869 ft (265 m). Hot water at a temperature of 177ºF (81ºC) was encountered at approximately 705 ft (215 m) (Therma Source, Inc., 1982). Robinson and Pugsley (1981) reported surface temperatures in the area ranging from 150 - 192ºF (66 - 89ºC) and geothermometers point to a resource temperature of from 176 to 237ºF (80 to 114ºC).

UTILIZATION

The Elko Junior High School well provides heat to serve 16 public buildings through 11 interconnections. The buildings served include Elko Junior High, the Convention Center, City Hall, City Pools (pool heating), City Pools (space heating), the hospital, Elko High School Vocational, Elko High School (six buildings), and the Centennial Gymnasium (including central kitchen building) central office building (includes service and maintenance building and warehouse). The total building area is 348,680 sq ft (32,393 sq m) of which 304,971 sq ft (28,333 sq m) is heated geothermally. Estimated peak geothermal flow is 309 gpm (19.49 L/s) with a peak heating load of 10,708 kBtu/hr (3,136 kW_t). The average delta T is approximately 34.8ºF (1.6ºC) with a peak delta T of 43.5ºF (6.4ºC). Two of the connections are to the return loop, including the pool heating portion of the city pool's heating load, and Elko Junior High's heating load is also served from the return loop. The Elko Junior High domestic hot water heating load is served with geothermal fluid directly from the well side of the geothermal heat exchanger.

The geothermal fluid from the geothermal well is transferred to a secondary circulating loop at the junior high school via a plate and frame heat exchanger for space heating. Discharge from the system is 110-140ºF (43-60ºC) and goes to holding ponds and eventually to the Humboldt River. Disposal of the fluid has become a major issue and both EPA and the State of Nevada are requiring that there be no flow to the Humboldt River due to down river water quality problems. The circulating loop is welded steel pipe, insulated and jacketed. Each building is connected to the circulating loop via a plate and frame heat exchanger, and each consumer is required to provide their own backup/peaking capability.

Recently, a new building on the Great Basin College (CBC) campus was connected to the system and raised concerns as to whether or not the system was adequate to meet the needs of the new customer as well as additional buildings on the CBC campus. The expansion to the five existing buildings on the campus would result in an increase in the peak demand of approximately 2,440 kBtu/hr (715 kW_t) and an increase in peak flow of 122 gpm (7.70 L/s). Preliminary analysis done by the Washington State University Energy Program indicates that the system would be inadequate as it is now configured to meet this additional load without significant capital improvement. Several alternatives were identified, including increasing the diameter of some piping runs, installing a booster pump within the distribution loop or installing a peaking boiler. During a recent site visit, it was found that the old hospital has been converted to office space, and that there may be sufficient boiler capacity at that site to provide peaking and backup to the entire system. This would result in a more robust system, minimize the need for customer backup systems and also reduce peak flows and associated disposal issues. Further evaluation of this alternative will be carried out over the next several months.

OPERATING COSTS

No cost figures could be obtained relative to the construction of the original system or cost of individual entities connecting to the system. Cost of operating the system is covered by an annual $5,000 assessment to each of the four entities that receive service from the system. Individual entities, however, must cover any costs that may be required related to their equipment operation, maintenance, repair or replacement. Additional or special assessments may be levied to cover system costs in excess of the $20,000 or when possible, such costs may be covered by funds held in a reserve fund created for that purpose. Savings to the four entities are estimated to exceed $250,000 per year and in 2002 exceeded $285,000 (Elko School District, 2003).

REGULATORY/ENVIRONMENTAL ISSUES

The most serious environmental/regulatory issues are related to the disposal of geothermal fluids. The system does not have an injection well and at present all disposal is via surface means with some flows reaching the Humboldt River. Both EPA and the state of Nevada are requiring that no flows reach the Humboldt River. The main concern is associated with increasing temperature in the river. The school district is considering several alternatives to address the disposal issue, including diverting the flow to effluent ponds at the golf course or possibly using abandoned sand and gravel pits as percolation ponds. A more drastic solution would be to limit the amount of geothermal flow, requiring that consumers rely upon backup boilers during periods when heightened flows of geothermal would be required to meet peak demand. WSUEP has recommended that a central peaking plant could be a better alternative and existing boilers at the old hospital will be evaluated for this purpose.

PROBLEMS AND SOLUTIONS

The system has experienced few real problems since being put online in 1985, with the exception of one pipe break as a result of external corrosion--the piping system is not jacketed. This could also result in additional problems in the future. Although major problems have not plagued the system, there appears to be little overall system management or coordination, and various entities have essentially free rein to connect as they please. This has resulted in some minor but potentially major problems as with the pool system; when, booster pumps have been installed that actually tend to pressure the return line in a reverse direction.

A more pro-active management approach with better overall system management and control would seem to be critical to future successful operation. Recently, concerns over disposal have forced system operators to seriously look at either reducing peak geothermal usage or find alternative disposal options. Finally, the system is operating pretty much at maximum capacity and expansion to the GBC campus would severely stress the system and most likely result in an inability to meet peak demand if significant capital improvements are not initiated. Options appear to be replacement of some piping runs with larger diameter pipe, installation of booster pumps in the distribution line or provision of central peaking to allow for peak loads to be met through increasing temperature in the distribution loop as opposed to increasing flow, as is now the only alternative. The availability of presently under-utilized boilers at the old hospital only some tens of meters from the distribution loop would seem to provide an excellent opportunity to provide peaking; thereby, not only increase capacity to a level that could adequately meet the needs of expansion to the GBC campus but also minimize peak flows and thereby, disposal problems.

CONCLUSION

The Elko County School District district heating system has successfully provided for the heating requirements of the buildings connected to the system over the past 22 years. The system saves over $250,000 per year in energy costs to the four public entities receiving service from the system. The desire to extend service to the GBC campus as well as comply with increasingly restrictive requirements for fluid disposal could well be met through use of existing boilers at the old hospital to meet peak system demand. The closed loop system provides an interesting contrast to the Elko Heat Company system where geothermal fluids are circulated directly to each consumer.

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