KLAMATH COUNTY
VANDENBERG ROAD COMPLEX

Gene Culver
Geo-Heat Center

LOCATION

The Klamath County Vandenberg Road Complex is located on the eastern edge of Klamath Falls in south central Oregon. Elevation at Klamath Falls is approximately 4,100 ft and the climate is characterized by an annual total of 6,500 heating degree days. The complex is on a hill top about 100 ft higher than the surrounding terrain and originally, somewhat isolated but some residential and businesses are recently developing nearby.

RESOURCE

The complex well produces from the same aquifer as most of the other 550 wells in Klamath Falls. Geothermal water issues from northwest trending faults bordering the east side of town. Water flows in a generally southwest direction from the major faults cooling and mixing with surface water as it proceeds. Temperatures reach a maximum of 220°F nearest the fault. At 151°F, the well serving the complex is 10 - 15°F warmer than nearby wells, but it is also deeper. Water chemistry is relatively benign with pH of about 8 and total dissolved solids of 800 - 1,000 ppm. Isolation heat exchangers are typically used since the water contains approximately 0.5 ppm hydrogen sulphide.

The county complex utilizes one production well 1,400 ft deep. The original pump test produced 760 gpm of 151°F water with a drawdown of 38 ft. A note on the pump test report reads "Well is capable of pumping more water. We need a larger test pump."

Water is injected into a 1,154-ft deep well that tested 210 gpm at 134°F with no measurable drawdown.

UTILIZATION

The history of the complex is somewhat sketchy. Some of the drawings and most of the mechanical specifications for the buildings kept by the county were lost or misplaced after the September 1993 6.0 earthquake. County building and engineering departments were moved and split up several times because their offices were badly damaged and temporary offices were utilized.

Work at the site started on August 10, 1960, when a cable tool well drilling rig was moved in. The well, now the injection well above, was completed as a production well at 1,154 ft on June 10, 1961. A second well, the original injection well, was completed in October 1962 at 205 ft and accepted 75 gpm with water level raising from 130 ft to 82 ft below the casing top.

The Juvenile Detention Home, located near the wells, was the first building at 18,300 sq ft. It was occupied in late-1962. The home had radiant floor heating and domestic hot water supplied by tube-and-shell heat exchangers. The well was equipped with a 7 ½-hp 88-gpm submersible pump set at 150 ft.

In 1954, the County Health Department building, about 5,500 sq ft, now the County Sheriffs Office, was occupied. The building had two heating air handlers (no cooling) supplied from a hot water boiler, probably oil-fired. About 1974, the Mental Health building at 3,880 sq ft was built. The heating system is believed to have been one or more oil-fired forced-air furnaces. About the same time, there was a small, about 600 sq ft, addition to the Juvenile Detention Home. Heating was by radiant floor utilizing the existing system.

In 1979, the Oregon State University County Agriculture Extension Office was built. The building was 8,440 sq ft, and had eight air-source heat pumps for heating and cooling.

In 1982, drawings for the retrofit of the well house for the Juvenile Home called for replacement of the tube-and-shell heat exchanges with a plate-and-frame exchanger, connection to existing underground insulated piping to the Health Dept., Mental Health and Extension buildings, and the addition of a plate-and-frame exchanger and cooling tower, a four-pipe system. These drawings show a fluid coupling variable-speed drive on the wellhead. It appears that some time earlier, the Juvenile Home radiant floor system had failed and been replaced by four fan coil units, and the County Health, Mental Health and Extension Offices had been converted to geothermally-heated four-pipe heating and cooling system. It is believed the fluid coupling and motor were 25-hp, but no records could be found.

In 1988, the new well for the then proposed County Jail was completed (above) at 1,400 ft and 151°F. The well was located off the hill and nearer known higher temperature wells, but does require about 100 ft of lift from the well to the buildings, about 200 ft total lift at current flow rates (100 ft pumping level).

The County Jail, 42,600 sq ft, was completed in 1990. The production well serving the Juvenile Home, County Health, Mental Health and Extension Offices converted to an injection well and the entire complex supplied from the new well. The system schematic is shown. Flows shown are peak design from drawings and are probably never that high. The jail has six fan coils, reheat boxes and unit heaters supplied from a main stainless steel plate heat exchanger. A separate heat exchanger supplies hot water for showers, kitchen, laundry, etc.

The Community Corrections Center, 19,500 sq ft, was occupied in 2003. The heating is provided by two large air handlers with hot water coils and a number of reheat boxes. The building is supplied from the main heating heat exchanger in the jail's mechanical room.

In January of 2004, a 9,000-sq ft addition to the Juvenile Home was occupied. The heating system utilizes two fan coils and reheat boxes supplied from the heat exchanger outside the home.

Currently, the total building area is just under 100,000 sq ft with future additions in planning stages. The design peak load is unknown; since, most of the specifications are not available, but is estimated at approximately 5.6 million Btu/hr plus domestic hot water. A totalizing flow meter indicates the average flow for the year of 207 gpm. The pump motor is on a variable-frequency speed control, but the control system is not yet completed so it is on manual control. There are, however, flow control valves at the mechanical room responding to heating requirements. Monthly average flows vary from a high of 325 gpm down to 116 gpm.

OPERATING AND MAINTENANCE COSTS

Practically nothing is known about operating and maintenance prior to the current maintenance staff, about 10 years. It is believed the submersible 7 ½-hp pump was repaired or replaced at least once, perhaps twice. The 25-hp variable-speed drive and pump were probably never repaired or replaced, but their life is unknown.

The existing heat exchangers in the jail mechanical room were cleaned about 1995 when it was noted that the pressure drop across the exchangers had increased. At that time, corrosion products from the well were found in the exchangers geothermal side. There was also some scale buildup on the clean water side assumed to be from lack of corrosion/scale inhibitors in the closed loop. Shortly thereafter, pressure drop across the exchangers began to increase again and it was apparent the pump needed to be pulled and repaired. It was also obvious that the 120-hp motor, variable-speed fluid drive and 12-in. pump bowls were oversized for the existing load; so, it was decided to replace them with a smaller pump and variable-frequency drive.

On pulling the pump, it was found that about 100 ft of pump column was corroded. The 120 ft below the pumping water level and the pump were in good shape.

In August of 1997, the pump was replaced by a 9LA 14-stage pump with 9-in. bowls, 100 ft of new column, new shaft, oil tube and bearings, and a 60-hp motor with variable-frequency speed control. Although the shaft, oil tube and bearings were in good condition, the new pump required a smaller shaft; so, the assembly was replaced. The pump was salvaged and put in service without repair in an irrigation well, where it remains today. Total cost was $37,492.50.

At the same time, the jail mechanical room heat exchangers were cleaned and new gaskets installed. Total cost was $2,300. The exchangers are currently (February 2004) in good condition with no leaks.

As noted above, the DDC controls for the jail have not been completed; so, the pump is on manual speed control at about 40% speed. Immediately after the new pump was installed, total power costs for the jail were over $1,000 less per month. Since there were no other changes, it was attributed to the pump–a simple payback of less than three years.

At the time the pump was installed, an electricity meter was installed on the pump with the thought of charging individual buildings a share of pumping costs based on building size. This never occurred; however, the use was recorded over 19 months, August 1997 - March 1999. At current electricity cost, the average cost per month would be $953.

Totaling the gallons pumped for the same months (albeit different years) and assuming a temperature drop of 30°F, the cost of natural gas replaced by geothermal would be $18,500 per month.

REGULATORY/ENVIRONMENTAL ISSUES

There have been no problems. Drilling low-temperature geothermal production and injection wells in Oregon requires only a start card and completion report (depth, lithology, water bearing zones, casings); unless, it is in a critical water area. The system was designed to meet the city ordinance geothermal injection requirement.

PROBLEMS AND SOLUTIONS

Aside from the oversized pump and corrosion of the pump column noted above, the only problems have been with the outdated pneumatic controls. These are being converted to DDC also as noted.

CONCLUSIONS AND RECOMMENDATIONS

The original 120-hp pump was grossly oversized. It was sized either based on the maximum well capacity or plans to greatly expand the facilities, which never came to fruition.

The system has operated without any major problems for some 40 years and grown over 5 ½ times the original size, while changing system configuration as growth required. Currently, the system is saving $210,000 in operating cost per year.