CALIFORNIA CORRECTIONAL CENTER
SUSANVILLE, CALIFORNIA

CCC in foreground, Honey Lake Valley and Diamond Mountains to the south.

LOCATION

The California Correctional Center is located in Honey Lake Valley of northeastern California, about seven miles east of Susanville in Lassen County. The facility, operated by the state of California, was converted to geothermal heating in 1983. The facility houses around 5,800 minimum custody inmates, and some 1,100 custodial and support staff are employed at the 1,112-acre site.

RESOURCE

Two wells, approximately 1,400 feet deep, were installed on a tract of land some two miles east of the site by the Carson Energy Group, Inc. of Sacramento (1981 and 1983). The wells are located just south of the Modoc Plateau volcanic region in lacustrine gravels and near-shore deposits of pluvial Lake Lahontan, which is cut by a small west-northwest striking lateral fault. The wells are owned and operated by the city of Susanville, the surface land owner, but a royalty is paid to the subsurface landowner. One well produces 169EF water and the other delivers 162 to 165EF water. In 2001, the casing on the hotter well collapsed and was deemed too costly to repair, and the cooler well has been used since then. Four binary power plants and a small district heating system in the city of Susanville also use geothermal heat in the area (170 to 230EF). The water has about 600 ppm with mainly sulfate, sodium, chloride, and bicarbonate species, and with trace amounts of hydrogen sulfide, boron and arsenic that exceed drinking water standards.

UTILIZATION

Geothermal heat is used for 50 to 80% of the prison's space and domestic water heating, as well as for a medium-sized greenhouse. It is supplemented by the existing diesel-powered system. The geothermal heating is used for inmate dormitories, but generally not for the staff areas. Heat is supplied by a centralized force-air duct system to individual rooms. The estimated peak heating load is 158 therms/hr and the annual load is 434,000 therms for a utilization factor of 0.255 and a peak capacity of 4.65 MWt.

A 75-hp oil-lubricated pump produces about 300 gpm into an underground supply line (asbestos cement and iron piping) to the prison boiler room. After passing through a sand filter, the supply water is routed to one of two plate heat exchangers for space heating and a small heat exchanger for domestic hot water. Incoming water on the closed loop system is about 70EF, and the outgoing water on the domestic loop is

heated to about 124EF using a stainless-steel plate heat exchanger. Water going out to the space heating loop is usually heated to 140 to 150EF when needed in the winter time. Three 30-hp pumps produce flows in the space heating loop as needed. After being passed through the heat exchangers, the 140 to 150EF geothermal water is sent to a medium-sized greenhouse about 500 yards to the east. Here a portion of the hot water is diverted and passed through a manifold heating system underneath two lengths of plant trays. This heating is used during cool periods to maintain a fairly constant temperature of 72 to 79EF in the greenhouse.

After the geothermal water passes through the greenhouse, it is returned to the city and distributed to a dispersion area consisting of a 20-acre application area and a 200-acre evaporation pond. The water is sprinkled over the application area to either evaporate or drain into an overflow pond. Some of the water flows directly into a privately-owned pond that supports bass, waterfowl, deer and antelope. Cottonwood trees and other riparian species have established themselves around the perennial pond. The estimate temperature of the water coming into the pond is around 122EF.

OPERATING COST

The initial capital cost of the system installed in 1980 is unknown, and has probably been amortized over the past 22 years. The well are estimated to have cost around $180,000. At present, the state of California pays the city of Susanville $17,062 per month on a "take-or-pay" basis, which allows them to use up to 525,000 therms/year. This cost includes the well pump, electricity cost, maintenance and overhead for the city. In addition, the prison Chief Engineer of Plant Operation estimates that slightly less than $1,000 per year is expended for repairing pipe leaks (about one repair per year in the 10"-pipe) and for other routine maintenance work. This then works out to about $0.39/therm. If the measured usage exceeds the 525,000 therms/year, then a charge of $0.39/therm is accessed for the additional amount.

The city of Susanville, which supplies the geothermal water, budgets $150,000 per year for this operation. This includes: $22,500 for personnel, $20,500 royalty to the property owner (amounting to $0.04/therm), $70,500 for services and supplies (which includes $20,000 for utilities), and $36,500 for overhead (accounting, billing, etc.). This amounts to about $0.29/therm. The actual pumping energy use for the year 2001/2002 was 323,200 kWh at a cost of $27,205.

The competing fuel is natural gas, for which the city charges $1.22/therm, diesel at slightly under $1.00gal = $0.70/therm, and electricity at 6.9cents/kWh = $2.02/therm. Thus, the savings to the prison would be slightly over $36,000 per month as compared to natural gas supplied by the city and a saving of about $13,500/month compared to diesel. However, a recently installed state-owned natural gas pipeline in the area may replace many of the area's current geothermal operations, including that of the prison, the price yet to be determined. This may occur when the current contract runs out in 2007.

ENVIRONMENTAL IMPACT

While the system does not have an injection well, the disposal of the geothermal water on the application area and associated ponds appear to have minimal environmental impact. There does not appear to be any corrosion or scaling problems in the system, especially since plate heat exchangers are used to isolate most of the secondary system.

REGULATORY ISSUES

No major problems were encountered with the permitting process. The project required an environmental assessment for Lassen County, a discharge permit from the California Water Quality Control Board, and a well drilling and completion permit from the California Division of Oil, Gas and Geothermal Resources. If built today, the project would also require a wet lands permit.

PROBLEMS AND SOLUTIONS

The only major problems are the replacing of the well pump bearings, bowls or shafts about every three years at a cost $10,000, and breaks in the supply line (about one per year) at a cost of $800/year. These, however, appear to be normal operating costs. They recently upgraded the variable-speed drive on the well pump from fluid coupling to variable frequency, due to the cost of replacement parts for the older system. One well did collapse after 20 years of use and is no longer used.

CONCLUSIONS

The system appears to be operating without major problems and is cheaper than current alternative fuel costs. Cheaper gas from a state-owned natural gas pipeline may replace the geothermal heat in 2007; however, the price has not been established at this point.

REFERENCES

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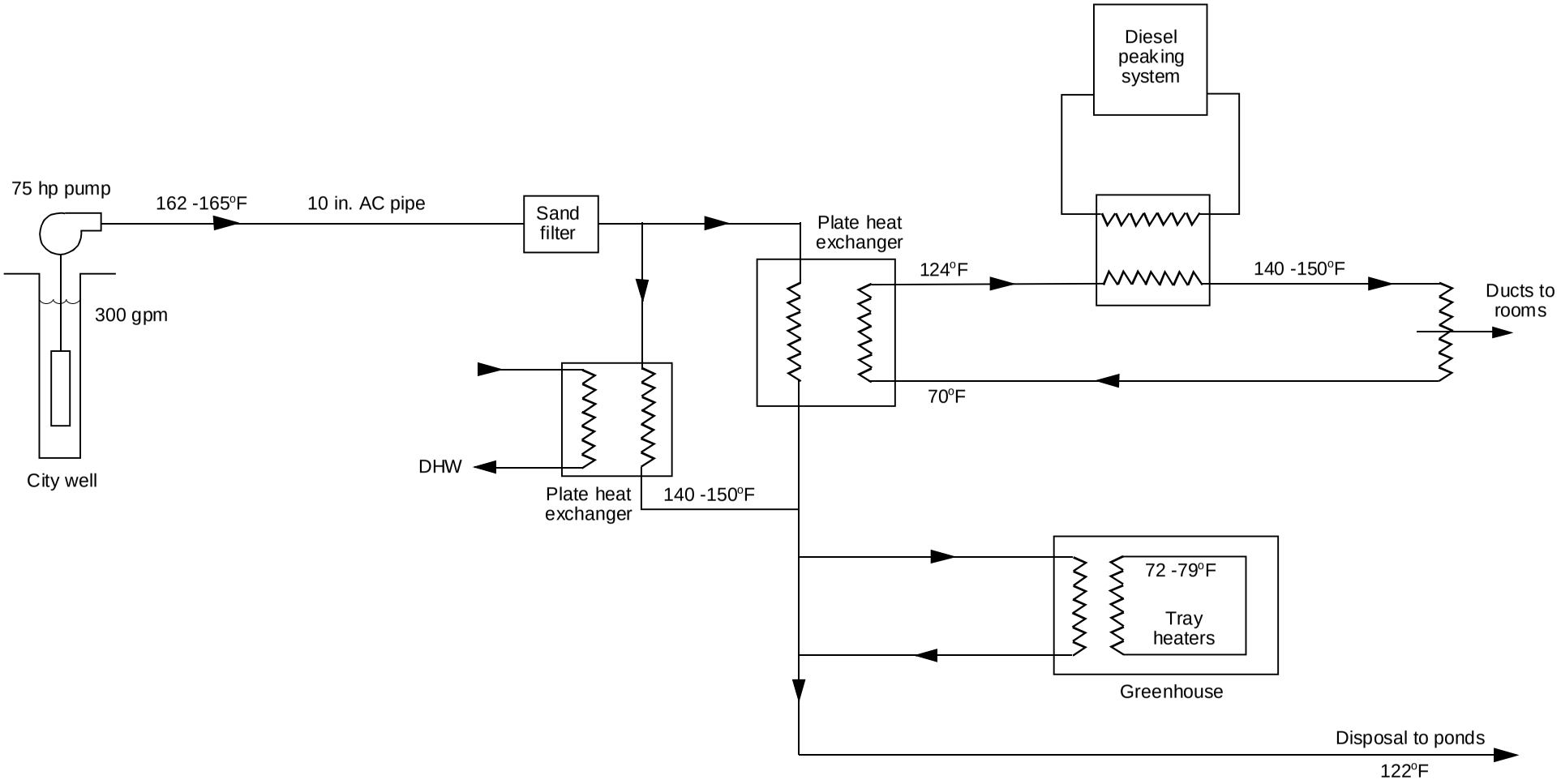

California Correctional Center Geothermal Schematic