MILGRO-NEWCASTLE GREENHOUSES
NEWCASTLE, UTAH

LOCATION

The Milgro facility is located just west of the town of Newcastle, UT, approximately 37 miles west of Cedar City in southern Utah. The elevation of approximately 5,000 ft results in substantial heating requirements and below zero temperatures are commonly encountered in the winter. Milgro is the largest potted plant grower in the U.S. and in addition to its 1,000,000-sq ft geothermally-heated facility in Newcastle, it also maintains substantial conventionally-heated operations near Los Angeles.

RESOURCE

The Newcastle area has long been recognized as rich in geothermal resources. Prior to the initial development of the Milgro facility, there were three other geothermally-heated greenhouses in the immediate area (all except one now owned by Milgro). There are currently numerous wells in the area producing water in the 190º F to 205ºF range. The wells all penetrate sediments of the Escalante Valley consisting of alternating sequences of clay, silt, sand and gravel. The source of the fluids is thought to be from a buried point source associated with a range front fault approximately 3/4 mile southeast of the main production area (Blackett, 2001). The geothermal fluids flow laterally toward the northwest through the permeable portions of the sediments. Wells individually produce flows up to 1500 gpm.

Recently, production at the Milgro facility has fallen off in the #2 well. In addition, a new injection well, despite intersecting substantial intervals of apparently permeable materials, does not accept the expected flow.

UTILIZATION

Two production wells equipped with vertical, oil-lubricated lineshaft pumps produce the flow for the system. The wells are both approximately 600 ft deep. Water from the two wells (1700 gpm at peak) is delivered to the greenhouse facility; where, the pressure is raised by individual 30-hp booster pumps for each of three 224,000 sq-ft-ranges. From the booster pump, the water is delivered to individual sub- zones in each range where a 4-way valve diverts the water either to the heating tubes under the benches or to disposal. Prior to the development of the two most recent ranges (#4 and #5), the water was all disposed of in a single injection well or to the surface (when flows exceeded the capacity of the injection well). With the development of the two newest ranges, water previously disposed of directly is now routed through the new ranges.

In the original three ranges, heating is provided by half-inch diameter EPDM tubes installed under the benches. This places the heat at the plant root level for maximum effectiveness in potted plant production. In the two newer ranges, which were developed for cut flower production, heat is supplied by two different systems--½-inch diameter tubes on the floor and 1-1/4-inch diameter overhead finned pipe. Effluent water from the other three ranges is boosted by two individual pumps for ranges 4 and 5--one 7 ½ hp for the overhead finned pipe and one 15 hp for the tubes. The head house building is heated with 18 unit heaters connected to the distribution pipe to the ranges. All distribution pipe for the ranges is steel with grooved end joining and is located overhead in the head house. Typical greenhouse inside temperature is 72ºF day and 65ºF night and varies with the crop.

Disposal of the water is a combination of surface and injection. The first injection well was drilled in 1993 and for several years accepted almost all of the system effluent. It was equipped with a pressure diverting valve such that water in excess of what the well could accept was diverted to surface percolation ponds for disposal. A new injection well was drilled in 2002 with the hope that it would accept all of the system effluent.

Using a figure of 23 acres, the peak geothermal heating load is approximately 51 million Btu/hr (14.9 MWt) based on an outside design temperature of 0ºF. The annual use is approximately 93 billion Btu; assuming, that 75% of the sunlight hours, the sun meets the heating load.

OPERATING COSTS

Operating costs, specific to the geothermal portion of the greenhouse are not available from Milgro; however, some general cost data can be inferred from available information. The total maintenance budget for the facility is $16,000 per month. This figure includes maintenance on the structures, vehicles, electrical systems, plant growing equipment and the geothermal system. An interesting point is that this amounts to less maintenance per square foot for the geothermal facility than for Milgro's conventionally-heated greenhouses in the Los Angeles area --though this is related to the fact that the conventionally heated structures are much older.

The geothermal system includes a total of approximately 485 hp in connected load associated with pumping (well pumps and booster pumps) and approximately 9 hp in unit heater fans. Assuming that the well pumps are operated in rough proportion to the heating requirements (#1 well pump is equipped with a variable-frequency drive) and that the booster pumps are operated more or less continuously in the heating season along with the unit heater motors, a total electricity consumption of 1,500,000 kWh per year would result. At a cost of $0.045 per kWh, this would amount to approximately $67,500 per year.

REGULATORY/ENVIRONMENTAL ISSUES

Geothermal fluids in Utah are regulated as "a special kind of underground resource." The use of or injection of the fluid constitutes a beneficial use of the waters of the state and as such water rights are required from the State Division of Water Rights. In addition, rights to a geothermal resource or fluids are based upon the principle of "correlative rights" conveying the right of each landowner to produce his equitable share of underlying resources. Well construction and permitting is regulated by the Division of Water Resources of the Department of Natural Resources. Because all of the facilities fluids are injected no special environmental permits associated with disposal are required.

PROBLEMS AND SOLUTIONS

Despite the very large size of this system, operation has been very reliable over the nine years it has been in operation. In general, the early problems were in the area of hardware and the more recent problems have been associated with the resource. The initial design of the system was based upon the use of plate heat exchangers to isolate the heating system from the geothermal fluid. Due to slow system response time, these heat exchangers were removed from the system in 1995. Since that time, geothermal water has been used directly in the heating equipment (primarily EPDM tubing). The relatively benign nature of the water (approximately 1100 ppm TDS, pH 8) has resulted in few problems. One area that was troublesome was that of control valves. These valves are used throughout the system to provide temperature control for individual zones in the ranges. Numerous failures of standard valves were experienced due to exposure to the geothermal water until replacement valves were coated internally with teflon. Well pumps encountered less than acceptable service life early on. In an effort to reduce failures in the bowl assembly, bearing lengths were increased and the result has been a typical service between overhauls for the pumps of approximately six years.

More recently problems have centered on wells and possibly the geothermal resource itself. An injection well was installed in 1993. This well was initially able to accept most of the system effluent however it periodically was necessary to pump the well to re-establish it's ability to accept water. In addition, this well did not have a sufficient enough surface seal to prevent water from migrating up along the casing to the surface. This caused erosion of the area around the well head. Eventually this well's capacity was reduced to the point that it would not accept a significant flow. A new injection well was drilled in 2002 several hundred feet north of the existing injection well. It is not clear at this point how much water this well will be able to accept.

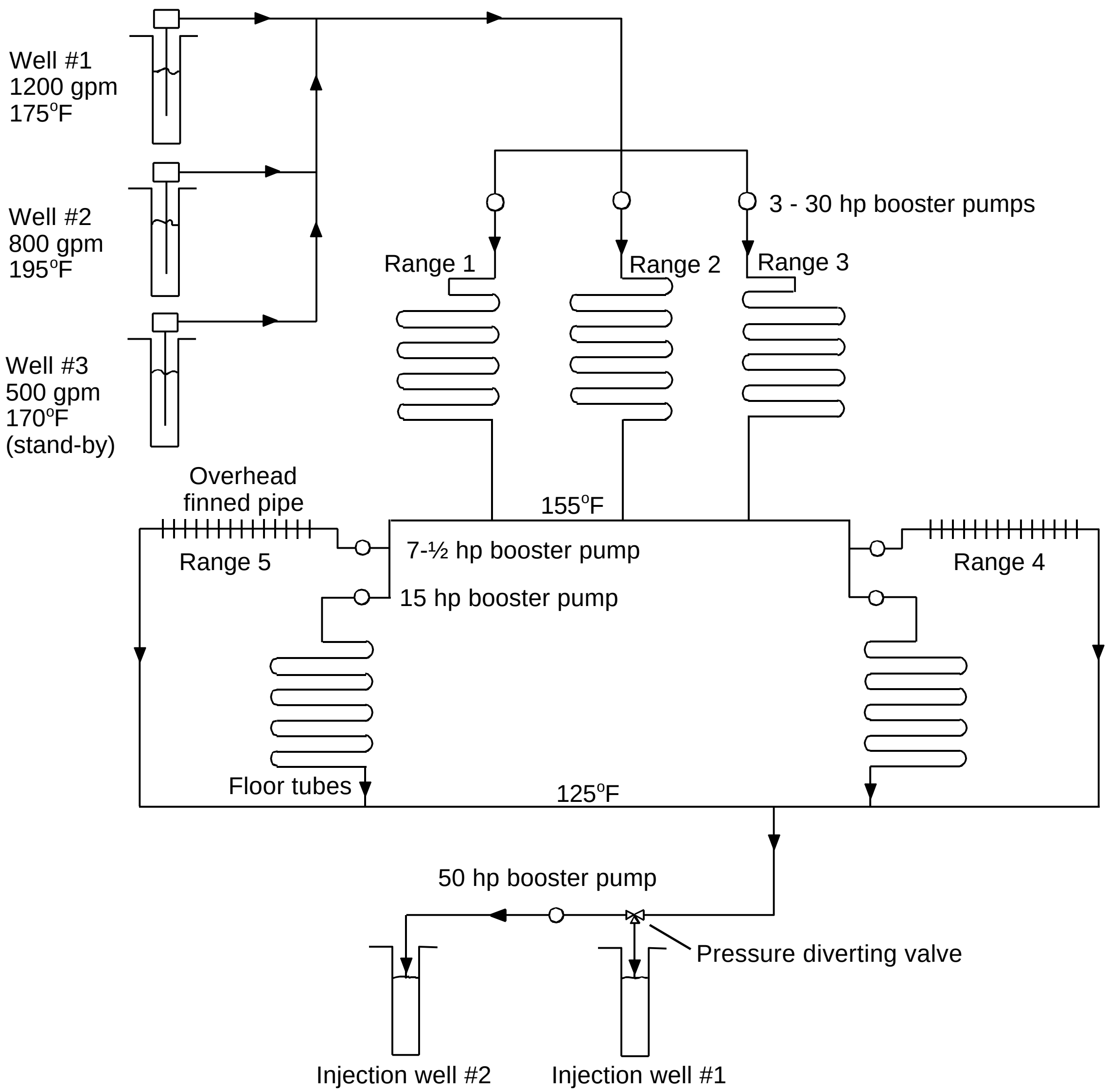
Production from well #2 has recently decreased by approximately 30%. It is not clear what the reason is for this since water level measurement facilities are not available in the wells. There has been some decrease in static levels (thought to be about 12 ft) but this should not be sufficient to eliminate key production zones. As a temporary measure, a pipeline is being installed to transfer water from another Milgro well located east of the wells #1 and #2. Production wells #1 and #2 have experienced drops in temperature of approximately 10ºF in the recent past. It is thought that the reduced flows and temperatures may be related to the ongoing drought in the area and the lack of complete injection of system effluent. These issues are the subject of ongoing work at this writing.

CONCLUSIONS

The Milgro-Newcastle greenhouse is one of the largest and most successful direct use applications in the country. The recent issues associated with the well performance are at least in part related to the substantial and rapid growth that the operation has undergone. It is expected that through careful monitoring and design, the local resource will be capable of supporting the existing and planned facilities well into the future.

REFERENCES

Blackett, R. E., 2001. "Newcastle Utah Small-Scale Geothermal Power Development Project." Report to NREL for Phase I Task II - Preliminary Well Development. Utah Geological Survey, Southern Regional Office.



Milgro-Newcastle Greenhouse Schematic