MERLE WEST MEDICAL CENTER
KLAMATH FALLS, OREGON

LOCATION

The Merle West Medical Center (MWMC)(formerly Presbyterian Intercommunity Hospital) is located in Klamath Falls which is in south-central Oregon. Elevation at Klamath Falls is approximately 4,100 ft and the local climate is characterized by an annual total of 6,500 heating degree days. The medical center complex is adjacent to the Oregon Institute of Technology (OIT) campus at the north end of the city of Klamath Falls. The hospital was originally constructed in 1964 and the geothermal system was added as a retrofit in 1976. Numerous building additions have been completed since--virtually all geothermally-heated.

RESOURCE

The MWMC produces from the same aquifer serving the OIT campus and most of the other 550 geothermal wells in Klamath Falls. The water issues from a northwest trending fault bordering the east side of town. Water flows in a generally southwest direction from the fault mixing with cooler surface water as it proceeds. Temperature of the water tends to reach a maximum of approximately 220°F nearest the fault. Water chemistry is relatively benign with a pH of approximately 8 and TDS of 800 to 1,000 ppm. Despite this, isolation is typically employed, since the fluid does contain a small amount (approx. 0.5 ppm) of hydrogen sulphide. MWMC is served by a single production well 1,583 ft in depth with a static level of 332 ft. The well was originally tested at a flow of 500 gpm of 195°F water with a drawdown of 15 ft.

UTILIZATION

The original geothermal system for MWMC was designed to provide space heat and domestic hot water to the 96,000-sq ft main building; a new 56,000-sq-ft addition; the adjacent 56,000-sq ft nursing home and snow melting for the main entrance area. Since that time, the approximate areas heated have grown to include 300,000-sq-ft main building; 45,000-sq-ft medical office building; 56,000-sq-ft nursing home and a 80,000-sq-ft residential care facility. The system as indicated in the attached schematic includes a production well producing a peak flow of 600 gpm of 195°F water and equipped with a 125-hp motor. The well pump is controlled to maintain a constant pressure at the upper end of the system. The water is delivered to a complex of six heat exchangers in the main building, one in the residential care facility and two in the medical office building. In all cases, loads are arranged in series such that a maximum delta T can be achieved. In general, flow control at each heat exchanger is provided by a 3-way valve which serves to either divert geothermal water through the heat exchanger or past it to subsequent loads.

After passing through the plate heat exchangers, the fluid is delivered either to a final snow-melt system or diverted to the injection well collection tank. Two 15-hp injection booster pumps provide the pressure necessary to deliver the water to the injection well. The injection well is 1912 ft deep and was added to the system in 1990 (see regulatory section).

The estimated peak heating load for the buildings is 21 million Btu/hr (6.1 MWt) and the annual use is 22 billion Btu.

OPERATING COSTS

Operating costs specific to the geothermal system are not maintained by MWMC. For purposes of accounting, however, costs are apportioned to different individual sub-facilities comprising the MWMC. For example, the 80,000-sq-ft residential care facility is billed approximately $0.024 per sq ft monthly to cover maintenance and capital improvements to the geothermal system. In addition, they are billed for the heat consumed as measured by an energy meter. Similar arrangements are in place for the other two major stand alone buildings.

The actual electrical energy input for the system in terms of operation is quite small relative to the quantity of energy produced. Based on an approximate design capacity of 21,000,000 Btu/hr, a total pumping requirement of only 165 hp is needed. The geothermal pumping is not separately metered but calculations indicate that approximately 430,000 kWh would be required on an annual basis to operate the systems production, snow melt and injection pumps.

The MWMC engineering department performs all regular maintenance of the system and its director estimates that the equivalent of one full-time employee is required to handle the maintenance of the geothermal system.

REGULATORY/ENVIRONMENTAL ISSUES

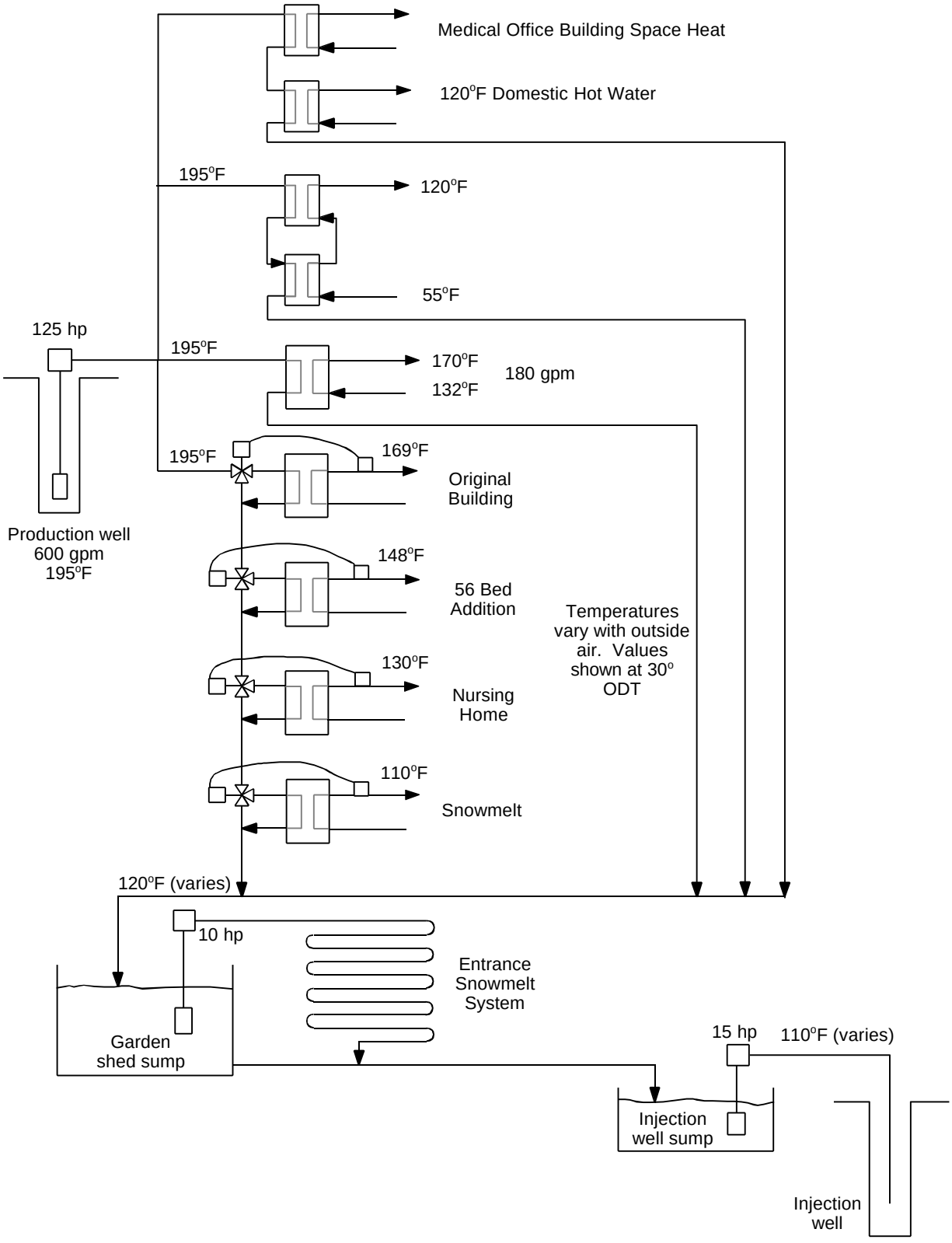
Few regulatory issues are associated with the operation of a system like this in the state of Oregon. Well drilling and construction is permitted in the same way as normal water wells with a start card and well completion report required to be submitted to the Department of Water Resources. Since the system is located within the city limits of Klamath Falls, injection is the required method of disposal. The ordinance requiring injection was passed in 1985 and stipulated that all existing systems would have to commence injection by 1990. As a result, MWMC completed a well for injection in 1990 to comply with the ordinance. Prior to that time, effluent was disposed of on the surface with drainage to Klamath Lake. Due to the age of the system, no permits were required. Injection requires only the submission of a one page summary form to the Department of Environmental Quality.

PROBLEMS AND SOLUTIONS

The MWMC system has been in operation for nearly 25 years. In that period of time, numerous modifications have been made to the system some as the result of problems and some as the result of newly available equipment. The original design included a well pump controlled by a fluid coupling type of speed control. The well pump produced into a 4,000-gallon tank that was vented to atmosphere and from that point to the individual heat exchangers Relatively frequent well pump failures were experienced for a time and this was thought to be the result of a control sequence that maintained the pump in operation but at a speed that was insufficient to produce flow at the well head.. The control was reset to eliminate this mode of operation and pump life was then extended to an average of six years between overhauls where it remains today. In 1995, the pump was equipped with a variable-frequency drive for speed control and the tank was removed from the system entirely. The original design employed all shell and tube heat exchangers. This equipment was much larger than the current plate heat exchangers, more difficult to clean and less effective at heat transfer. In the mid-1980s, all of the original heat exchangers were replaced with plate and frame units. There has been some problems encountered with gaskets in the plate heat exchangers. Swelling has been encountered in some cases and this is thought to possibly be related to the small amount of oil in the geothermal fluid from the well pump (oil lubricated enclosed shaft type). Some problems have also been encountered with butterfly valve lining material. Fluroelastomer lined valves have been used but the cost is excessive and this problem is yet to be fully resolved. The injection system involves the use of a concrete sump in which “can” type vertical pumps are located. Originally, these pumps were standard, steel column, cast iron bronze fitted pumps. Due to the fact that the geothermal fluid is saturated with oxygen at this point in the system, the original pumps were plagued with failures. All stainless steel pumps were installed and these problems have largely been eliminated. A similar situation and remedy was experienced with the snow melt pumps located just upstream of the injection pumps. The original controls for the system were the standard pneumatic design of the day. These were replaced with a DDC system in 1990 and the operation and monitoring of the system was vastly improved according to the MWMC engineering department.

CONCLUSION

The MWMC system is one of the oldest large geothermal systems in the U.S. It has proven to be a reliable energy source for a critical facility for the past 25 years and has in the process accommodated substantial increases in capacity. The system currently displaces approximately 275,000 therms per year in natural gas purchases. In 1977, the total investment in the geothermal retrofit of $320,000 was expected to generate annual savings of approximately $104,000 per year when all additions envisioned then (total building area 275,000 sq ft) were completed. At this writing, the system is serving approximately 470,000 sq ft and as a result the savings have re-payed the original cost many times over.



Merle West Medical Center Geothermal Schematic