HEATING FACILITIES

Stepping Stones Rehabilitation Center
Klamath Falls, Oregon

March 1980

DISCLAIMER

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The following study is the result of a request to the Geo-Heat Utilization Center for Technical Assistance.

Introduction

The Stepping Stones Rehabilitation Center is leased from Klamath County and operated by the Klamath Council on Alcohol and Drugs. The center is located on the west side of Summers Lane about a third of a mile north of the South Side Bypass (Johns Ave.). Buildings consist of interconnected and adjoining buildings laid out in a "U" configuration, with a total floor plan area of about 13,000 square feet. Construction is conventional single story, with tile roofs, masonry facing on the walls, and single glazed windows. Heating is by room wall convectors using low pressure steam. Steam is generated in an oil fired boiler. The steam system is old, badly in need of repairs, and very expensive to operate. Center personnel have asked if the buildings can be heated geothermally.

Summary of Conclusions

It is economically feasible to heat Stepping Stones using a water to water heat pump. Low temperature geothermal water from a relatively shallow well would be boosted from 80°F to a 150°F in the heat pump. This hot water would supply space heating requirements and potable hot water. The existing boiler, steam and condensate piping, and room convectors would be removed.

The water to water heat pump, new piping, and room convectors would be installed. Estimated capital cost is $140,000. Annual energy savings in fuel oil purchases is about 26,000 gallons with a first year value of about $19,000. This savings, less operating costs, when applied with escalation considerations over a period of twenty years, results in a present worth of $91,778 when discounted at 10%. This is the amount of surplus generated after the payment of all obligations, when the project is financed with 10% bonds.

Availability of Geothermal Water

There is evidence of a geothermal resource in the vicinity of Stepping Stones. A line projected to the southeast passes through two existing wells that have low temperature geothermal water. The closest well about 700 feet out, and just off Selma Avenue, was drilled last year. It is reported to produce 83°F water from a depth of 155 feet. Further along this line, a distance of about 2,600 feet out, and on the north side of the South Side Bypass is the second well. The well log indicates it produces 72°F water from a depth of 78 feet. Based on this information is seems likely that a well located on this same line and out about 250 feet would produce 80°F water at a depth of 200 feet. The well would be located on the Stepping Stones side of the fence that bounds the County school shop buildings. The 80°F water is suitable for use with a heat pump. Lower temperature water can be used, but system capital and operating

cost decreases as the water temperature increases. No deep wells have been drilled in the area and it is unknown if geothermal water exists with sufficient temperature to permit direct utilization without use of a heat pump. The well should be drilled to a deeper depth if indications develop during drilling that hotter water may exist.

Energy Balance

The buildings are conventional single story construction with tile roofs, masonry facing on the walls and single glazed windows. The ceiling in the main building is insulated with mineral wool which is compacted, badly scattered and probably equivalent to an insulation resistance "R" value of only 0.5. The recreation room has a cathedral ceiling apparently with no insulation. To prevent the sprinkler system in attic areas from freezing, additional insulation was installed on the under side of the roof. This is 3 or 4 inch fiberglass batting with an aluminum vapor barrier with an "R" value of about 11. A temperature of 60°F is maintained in the attic with thermostatically controlled forced air convective steam heaters. Most of the movable windows are the double hung type, which are loose and leak air badly. Exterior doors have large cracks and also leak air. Based on the above, an outside temperature of 1°F, and an inside temperature of 65°F, a peak heat loss from all the buildings was calculated as shown in Column 1 below.

	PEAK HEAT LOSS (BTU/HR)		
	1	2	3
Walls	140,000	140,000	0
Doors	90,000	60,000	30,000
Windows	190,000	180,000	10,000
Roof	90,000	80,000	10,000
Floor	60,000	60,000	0
Total -	570,000	520,000	50,000

With proper weather stripping of doors and windows and reduction of the attic control temperature to 55°F, the losses could be reduced to the 520,000 BTU/HR shown in Column 2, a saving of 50,000 BTU/HR as tabulated in Column 3.

Estimated annual fuel used is based on quantities purchased in 1978 as tabulated below. Also tabulated is electricity purchased.

Month	Fuel Oil (Gallons)	Electricity (KWH)
January	3,452	6,070
February	2,840	4,619
March	2,960	15,798
April	3,645	14,872
May	2,607	12,637
June	1,335	12,360
July	0	16,480
August	27	8,760
September	797	9,268 (est.)
October	1,309	9,760
November	3,000	9,443 (est.)
December	4,099	9,126
Total -	26,071	129,193

Calculation, taking into consideration the portion of electricity consumed that contributes to heating, indicates that the annual consumption of fuel oil is over twice the amount that would be used by a modern, well maintained boiler heating system.

Description of Geothermal System

Figure #1, Flow Diagram Geothermal System, shows the basic plan for the proposed system. Included are heating duties, flow rates and key temperatures and pressures.

The geothermal production well will be located several hundred feet southeast of the building just on the Stepping Stones side of the fence that bounds the County school shop property. A well bore of 12" with 10" casing to a total depth of 200' is anticipated. This well should produce the peak requirement of 64 gallons per minute of 80°F water. A deep well turbine pump with variable speed drive will require a 2 HP electric motor to deliver the geothermal water through the 3" discharge piping to the heat pump. This piping is 3" insulated and buried fiberglass reinforced pipe. At the heat pump a small portion (3 GPM) is split off to furnish the source of water for heating. The geothermal water is considered to be safe for potable use, and direct use in the heat pump evaporator. If this proves not to be the case, the system will have to be modified to provide for heat exchange at a minor increase in cost. For the purposes of this study a Westinghouse "Templifier" heat pump, TPB-060 series B, was selected. The water to the evaporator is recirculated to maintain a minimum flow of 80 gallons per minute to insure proper heat transfer. A small inline pump will provide this circulation. Cooled geothermal water will be injected in a well similar in design to the production well. The injection well will be located in the northwest corner of the property.

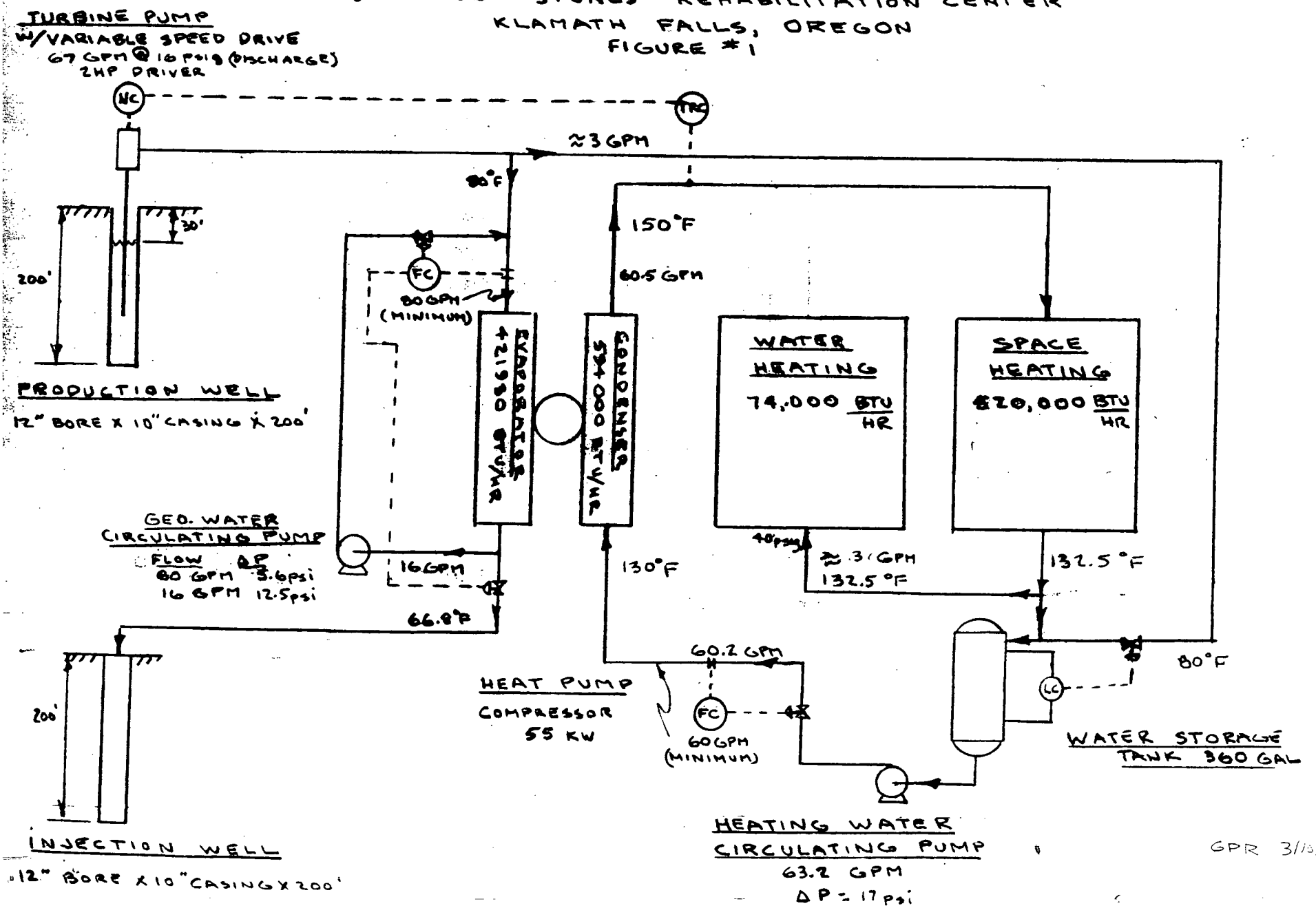
The heat pump compressors require 55 KW of electricity to compress the vaporized refrigerant to the higher temperature level. This electricity contributes to heating capacity of the system. The condenser extracts the heat by returning the refrigerant to liquid form. The extracted heat at 150°F is circulated through the new hot water finned coil convectors throughout the building to do the necessary space heating. This circulation is maintained at a minimum of 60 gallons per minute to insure proper heat transfer in the condenser. Return water at about 132°F is used as potable hot water. A water storage tank accepts the return water, and makeup water needed to offset the potable hot water consumed. Total peak duty for the heat pump system is 594,000 BTU/HR, with 520,000 BTU/HR to space heating and 74,000 BTU/HR for water heating.

Capital and Operating Costs

Table #1 summarizes capital and operating costs. Total capital is estimated at $140,000. This includes removal of existing steam boiler, steam and condensate piping, and steam convectors. An alternate that should be considered is to abandon the existing piping in place and install the new hot water piping on the outside of the building. Not included in the estimate are engineering or contractors' fees, permits or licenses, or cost escalation. Operating cost for the first year is estimated to be $6,087. This includes the cost of about 88,000 KWH/YEAR to operate the various pumps and heat pump compressors.

FLOW DIAGRAM GEOTHERMAL SYSTEM

STEPPING STONES REHABILITATION CENTER
KLAMATH FALLS, OREGON
FIGURE #1



GPR 3/10/80