NEW MEXICO STATE UNIVERSITY CAMPUS GEOTHERMAL DEMONSTRATION PROJECT - ONE YEAR LATER

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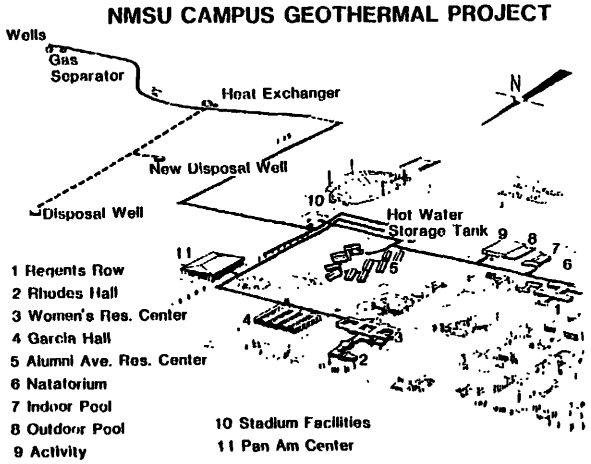
ABSTRACT

This summary presents the construction highlights and performance of the NMSU Campus Geothermal Project at Las Cruces, New Mexico. The installed system was funded by the New Mexico Legislature and DOE under a Cooperative Agreement. Construction started in July 1981, first system use was January 1982, and the system was dedicated on April 21, 1982. Geothermal hot water from NMSU wells is used to heat potable water, which in turn provides 83 percent of the domestic hot water on the NMSU campus, as well as space heat to two buildings, and for two heated swimming pools. System overall performance has been excellent, except for geothermal well pump problems. In terms of operating efficiency, the system has exceeded design parameters. In spite of abnormally high costs for well and pump repairs, the system has shown a positive cost avoidance of more than $118,000 for the first year of operation.

INTRODUCTION

The NMSU Campus Geothermal Project is the first large scale demonstration in New Mexico. It followed a series of small demonstrations funded by New Mexico, one of which was the President's House at NMSU, which is heated by its own well. Under the Cooperative Agreement, DOE provided funds for well drilling, project management, and monitoring for one year. A special appropriation by the NM legislature of $829,000 funded the system construction. Subsequently, the New Mexico Geothermal Demonstration Fund provided funding for a second disposal well, completed in October 1982, and for a deeper well, to be drilled in summer, 1983. The following figure depicts an overview of the system, showing general locations of the well and other facilities, in relationship to the eleven user complexes.

NMSU CAMPUS GEOTHERMAL PROJECT



CONSTRUCTION

As part of the DOE funding, a second new geothermal well was drilled, along with an observation well. These wells were completed in late 1980 and early 1981. At the time final system construction started, the production well field had been tested extensively. Because of the austere construction budget, construction was done in-house by the Physical Science Laboratory. A large crew of student employees was hired and trained, supplemented by temporary employment of professional construction workers. Skilled trades such as electricians, welders, masons, and other skills were employed on a purchase order basis. Construction highlights are shown in the following table.

CONSTRUCTION HIGHLIGHTS

Wellfield

- PG-1 complete Oct 79
- PG-3 complete Jan 81
- Observation well complete Nov 80
- Pumps installed July 81 and Feb 82

Disposal

- Old Golf Course Well Dec 81
- Disposal Pipeline Oct 81
- New Disposal Well Oct 82

System Facilities

- Pump Houses June 80 and March 81
- Transmission Power Line June 81
- Buried Pipelines Aug. 81
- Gas Separator Sept 81
- Heat Exchanger Building Oct 81
- Hot Water Storage Tank Jan 82
- Partial System Use Jan 82 (six months ahead of schedule)
- Tunnel Pipeline Jan-Feb 82
- Retrofit complete March 82
- Swimming Pools on-line March 82
- System Tests
  - Gas Separator Sept 81
  - Heat Exchanger Nov 81
  - Disposal Well Dec 81
  - Hot Water Storage Tank Jan 82
  - Full System Jan - March 82
- Instrumentation Feb - April 82
- Dedication April 82

SYSTEM PERFORMANCE

With the exception of well pumps, the system has met or exceeded design parameters, and has been relatively free from maintenance. System heat exchangers, which are TRANTOR plate and frame, consistently demonstrated a 2 F approach temperature. Geothermal fluid, which is 142 F at the wellhead, is producing 137 F water at the main campus three miles away. Three tear-down inspections of the exchangers show evidence of no corrosion, and negligible fouling. The insulated hot water storage tank, which holds 60,000 gallons and provides up to 400 gpm peak demand, is able to hold the stored water above 130 F for more than 47 hours. Both swimming pools are adequately heated, and the outdoor pool, which usually opens in May, was opened in February because of the availability of the inexpensive geothermal heat. At the gas separator complex, CO_2 is stripped from the water by pressure drop, and only minor maintenance has been required. The final valve, which throttles the fluid to a pressure drop of 40 psig, was replaced by a stainless steel valve body because of fluid and gas erosion caused by high velocities. For the geothermal well pumps, a less satisfactory performance has resulted. The pumps have had an average life of less than 1250 hours, and reduced life has resulted in significantly high costs. The problems are attributed to a combination of vendor quality control and sand. Most recently, the Johnston vertical shaft turbine pump failed because the pump column was eroded by H_2S. To solve the sand problem, NMSU is proceeding to deepen PG-1 to a target depth of 2,000 feet in order to produce from fractured carbonate rocks instead of the alluvial formation. The pump will be repaired with hard-faced bearings, and flanged column pipe to control the H_2S problem. The following table portrays a summary of well pump failures.

WELL PUMP PERFORMANCE

WELL	PUMP TYPE	LIFE (Hours)	REMARKS
PG-1	Peerless 50 Hp (VST)	1500	Failed during full load test
	TRW-REDA 100 Hp (SUB)	3000	Sand ruined pump
	TRW-REDA 100Hp (SUB)	30	Quality control
	Johnston 60 Hp (VST)	3500	Sand and H_2S; pump column failed
PG-3	TRW-REDA 100 Hp (SUB)	1000	Unknown; probably quality control
	TRW-REDA 60 Hp (SUB)	2600	Still in service

FINANCIAL ANALYSIS

Geothermally heated water is used to displace heat energy originally supplied by the NMSU Central Steam Plant. None of the facilities connected to the steam plant are metered, so direct measurements are not possible. Before the geothermal system was constructed, end-use consumption of hot water was measured by a special set-up of flow meters, temperature probes, and steam condensation meters. From these data, estimates were derived for probable steam (hence natural gas costs) displaced by the geothermal system. As a parallel approach, total natural gas consumption for the base year 1980 was measured and an empirical method was derived to take into account weather, major building and steam equipment changes, and operational factor changes. This latter method then was used to predict 1981 consumption, which it did within a 2.7 percent correlation. Then, by applying the method to show forecast changes for 1981 to 1982, a comparison with actual natural gas consumption could produce a relative measure of geothermal system performance. The two different approaches provide a measure consistent to within one percent. Based on operating costs, the system has shown a positive cost avoidance of more than $118,000 for the first year of operation. If the new well drilling program proves successful, and if well pump changes prove to prolong pump life to one or more years, future annual cost avoidance could reach $250,000 or higher, depending on future natural gas prices. The following table portrays operating costs by category, and natural gas offsets to the system to date.

GEOTHERMAL SYSTEM COST AVOIDANCE

Gross Savings		
Feb. - Sept. 1982	26,823 mcf @ $4.47	$119,899
Oct. 1982 - Jan. 1983	26,436 mcf @ $4.95	130,858
Feb. - Apr. 1983	18,756 mcf @ $4.79	89,841
TOTAL		$340,598
Operating Costs		
Electricity (Feb. 1982 - April 1983)		$ 38,587
Normal maintenance labor and materials		35,394
Abnormal costs for well and pump repairs		148,247
TOTAL		$222,228
Net Favorable Cost Avoidance		$118,370

FUTURE ACTIONS

As briefly mentioned, the existing production well, PG-1, will be deepened and completed to a planned horizon of 2,000 feet in late summer, 1983. Concurrently, NMSU is expanding the system by adding 148,000 square feet of geothermally heated space in two major buildings. These buildings will be connected and ready for use in Fall, 1983.

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