Geothermal Resources Council TRANSACTIONS, Vol. 16, October 1992

MAINTENANCE OF A MULTI UNIT GEOTHERMAL POWER PLANT

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ABSTRACT

A brief chronological order of the installation, type of power generation units, and use is presented. Several mechanical, electrical operational problems are discussed along with the solution of each. A preventive maintenance program has been implemented.

INTRODUCTION

The Sulphurdale Geothermal Field near Cove Fort, Utah was long known as a potential geothermal production area. For many years prior to the start of the production of electrical power elemental sulfur, used as a soil conditioner, was mined from the surface. In 1977 the Union Oil Company now UNOCAL Geothermal drilled two wells (No.42-7 and No. 31-33), both of which were completed as observation wells.

The official discovery well for the field is Well No. 34-7, which was drilled in 1984 by Mother Earth Industries. While being drilled ahead at 1300 feet this well blew-out demonstrating the existence of a shallow, steam reservoir possibly capable of sustained electrical production. Following the control and abandonment of Well No. 34-7 two production wells were drilled on federal leases and completed with 12-5/8 in casing. These two wells were used to power the first set of generation units. At present there are five production wells and one injection well, which is one of the original UNOCAL wells No. 42-7.

The first power production equipment was installed at the Bud L. Bonnett Geothermal Power Plant (BLP) in 1984. The facility consisted of four skid mounted 650 kw (.65 MW) binary units manufactured by ORMAT Energy Systems Inc. in Israel. These units were equipped with ridged Boshe type couplings between the turbines and generators. Over a period of months this configuration, which essentially did not allow a good alignment between two pieces of machinery, caused the failure of the bearings in the generators. This problem was solved by having the couplings machined in such a way as to allow proper alignment.

A second problem was with the incomplete vaporization of the fluid passing through the heat exchangers. Excess fluid passing from the heat exchangers eroded the exhaust ports and pipes. This problem was solved when the exhaust steam from the second power generation unit was directed through the heat exchangers, which eliminated the two phase flow.

The second power producing facility, a topping unit operating on dry steam directly from the wells, consists of a surplus Westinghouse World War II destroyer escort turbine (left hand), a gear box and Kato generator. This unit was modified to match the resource. As a topping unit it was placed between the wells and the binary power plants. Essentially, the binary units operate on the exhaust from this topping turbine. This unit went on line in March of 1988 producing 2 MW of power. It was designed and installed by Barber-Nichols Inc. of Arvada, Colorado.

A problem was caused by an omition in the steam gathering system from the wells to the topping turbine. A separator to clean the steam prior to entering the turbine was not installed. This problem manifested itself following a test to determine if some of the production wells were interconnected in the reservoir. The power plant owner Provo/UMPA had the Calpine Corporation inject air into a new well to observe the possible effects in nearby wells. This action caused some drilling mud and cement that was probably emplaced during killing and abandonment of the blowout well to enter production wells and pass through the gathering system into the topping turbine, which distroyed the outer portion of the rotor blades.

The turbine rotor was removed and another turbine was purchased and rebuilt to handle this steam by the Elliott Company in California. At this time the rotor and the blades were nickel plated. Prior to being placed back into service a separator was placed into the gathering system upstream from the turbine.

This unit also had a persistent oil leak in a part of the lube oil system, which was essentially constructed from screwed together sections of pipe. To avoid this problem it is recommended that such systems be welded instead of screwed together.

The third unit to go into service at the BLB power station was the 8.5 MW condensing turbine, gear box and generator set designed and supplied by the Geothermal Power Company of Elmira, New York with the civil work being done by The Ben Holt Company. The turbine is a surplus World War II cruiser unit, which was modified to fit the conditions at Sulphurdale. There was an initial problem with the steam separator that was installed in gathering system. When placed into service this stainless steel unit failed internally. It had to be replaced with a second unit from a new manufacturer; the same one who supplied the steam separator for the topping turbine. To date, no problems have been encountered with this separator or the 8.5 MW turbine it services.

The generator on this third unit was made by Ideal of Ohio, USA. It has leaked oil ever since it went into service in October of 1990 dispite efforts of the service representatives. About 2-1/2 to 3 gallons a day through the end seals. This problem is expected to be resolved during a scheduled shutdown in July of 1992.

On several occasions the power plant has tripped off line due to erratic frequency changes in the Western Utah Power Grid. This problem was caused by a low setting on the protective relays between the power station and the grid. It was solved by resetting the relays.

During plant number III start up the Nash vacuum pumps, used for the 8.5 MW unit condenser, have failed. For some reason the rotors would drag on the housing following shutdowns causing the metal to gaul. Nash has subsequently increased the clearence in the pumps, which has eliminated this problem.

A computerized preventive maintenance program for the mechanical and electrical components of all the power generation units has been developed and installed. This program is working very efficiently and should help to prevent serious breakdowns in the future.