

## Continuous Monitoring of Geothermal Steam to Mitigate SCC of Rotor Steel

### BACKGROUND

Geothermal steam contains many corrosive elements that can cause corrosion of power plant equipment including stress corrosion cracking (SCC) of rotors at high stress locations (*Fig. 1*). Mitigation of these problems requires a clear understanding of the corrosive nature of the steam as it first condensates. Varying steam conditions and properties, however, make this task virtually impossible in an off-site lab.

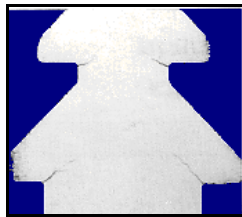


Figure 1: Blade-fit SCC

A major utility, which operates many geothermal units, commissioned MIS to study this problem and develop tools and methods for gaining the required information for mitigation of SCC problems of its rotors.

### DISCUSSION

SCC is caused by a complex interaction among a corrosive environment, a susceptible material, and high enough stresses (*Fig. 2*). For a rotor in a geothermal plant, material and stresses are the “known constants,” while the environment is the “great unknown.” This complexity is due to unknown phenomena in the reservoirs, the segregation mechanism of corrosive agents (such as chloride ions) in the first moisture, and varying steam conditions and properties during operating cycles caused by change in load, steam well connections, seasons, and time of day.

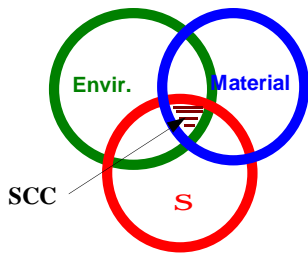


Figure 2: SCC Phenomenon

To understand and mitigate SCC of rotor steel, many studies had been performed in standard type “NACE” solutions, but their applicability to the actual field environment remained highly questionable. To address this complex issue, MIS designed, fabricated, tested,

installed, and now owns a portable lab (*Figs. 3 and 4*) in the geothermal facility for continuous on-line SCC testing. This lab measures operating parameters, steam conditions, and crack growth that will be used to identify specific conditions leading to SCC, the rate of SCC growth, and the threshold stress intensity factor for SCC.

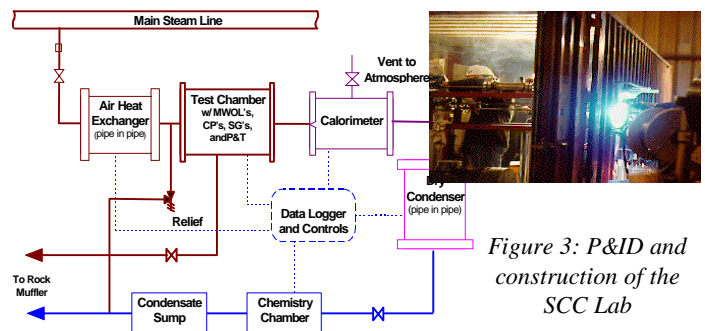


Figure 3: P&ID and construction of the SCC Lab

To make certain that this lab would operate properly, a number of new tools and methods were developed. Special considerations in this lab included:

- Ability to simulate steam conditions in the turbine near the first moisture
- Accurate on-line measurement of crack size of the cracked specimen in the environment
- Continuous on-line measurement of the corrosion potential of the first moisture using a new corrosion potential probe
- On-line measurement of steam condensate chemistry

### CONCLUSION

A portable lab was designed, manufactured, and successfully used to continuously monitor steam conditions and SCC growth of samples in a very harsh and varying geothermal steam field. This lab utilizes some innovative concepts and technologies which were developed during this project.