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**DEVELOPMENT AND IMPLEMENTATION OF A
RELIABILITY CENTERED MAINTENANCE PROGRAM
FOR GEOTHERMAL POWER PLANTS**

**FINAL TECHNICAL REPORT
FOR FINAL REVIEW
(REPORT # DOE-RCM-F)
AUTHORIZED FOR PUBLIC RELEASE**

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EXECUTIVE SUMMARY

Background

In today's competitive energy market many power plants are increasing their competitiveness by adopting new operating and maintenance philosophies to reduce their Operation and Maintenance (O&M) costs. For geothermal power plants to stay competitive, they must also adopt similar strategies to optimize their resources. Flexible operations (such as load-following) and adopting CBM programs are two powerful strategies with significant cost savings potentials for the geothermal plants.

Objectives

A research project was initiated with support from the Department of Energy (Grant #DE-FG07-00ID13916). The overall project goal was to *reduce operating costs* of geothermal plants and *increase reliability* of geothermal plant components. The specific project goals were to develop and implement a reliability centered maintenance (RCM) program to optimize maintenance activities for a geothermal power plant.

Specific project objectives were:

1. Identify and rank major components of a typical geothermal power plant (one of NCPA's Generating Units) which are affected by unit operation and are either safety related or essential for unit operation.
2. Select, among the above list, components that can benefit from changing their maintenance practice from a preventive approach to a condition based approach.
3. Develop individual and integrated CBM programs for these components to reduce maintenance cost and improve unit reliability by mitigating component failures
4. Develop guidelines and roadmaps for developing similar CBM programs for other geothermal power plants.
5. Implement and benchmark the developed CBM program at NCPA's Plant #2 consisting of Units 3 and 4.

Methods

A draft of a RCM program was developed for geothermal facilities of NCPA using existing technologies by a team consisting of all plant disciplines. The team started implementing this program at their facilities and as a result modified and updated the program to fit its specific applications. Training of team members to use various RCM technologies were conducted. The program was documented in reports and papers and presented in various forums to satisfy the technology transfer requirements. As the RCM program is a "live" document, it will be under continuous updates by the RCM team to best fit its intended applications.

Results

Initial implementation of the RCM program at NCPA geothermal facilities proved very successful in reducing maintenance costs. This was primarily due to team members approaching Facility Maintenance from the new RCM perspective. This knowledge has been a major factor

in plant personnel finding better ways of operating and maintaining the plant components, increasing the quality of inspections, and more efficiently using available resources.

Conclusions/Recommendations

This project developed and successfully implemented a RCM program for NCPA's geothermal facilities. Initial findings from the new program show an optimized maintenance approach resulting in large savings in maintenance resources. As part of the technology transfer, this program has been documented and presented at various forums.

As RCM is a live and active program, it must be continually reviewed and updated to better serve its intended functions. This requires a continuous level of interest and involvement from plant personnel to assure its evolution. Therefore, the foremost recommendation for developing and implementing similar programs at other sites would be to assure that the RCM team remains motivated in its use of the program. Periodic Team Meetings and Training Sessions are an excellent means to motivate and maintain enthusiasm.

Summary

NCPA is continuing to develop a Reliability Centered Maintenance (RCM) program for its geothermal assets. The goal of this project is to make NCPA's geothermal power plants more cost-effective and hence more competitive with other types of power plants.

This report describes the development of the RCM team, identifying plant assets and developing an asset hierarchy, the development of sample Failure Mode Effects Analysis (FMEAs), identifying and prioritizing plant systems and components for RCM analysis, and identifying RCM/CBM software/hardware vendors. It also includes the Failure Mode Effects Analysis (FMEA) for all Class I Systems, Maintenance Task Assignments, use of Conditioned Based Maintenance (CBM) Tools and Displays of the RCM Software System Development to date.