Operation and Maintenance Training

Geothermal Power Plants

Deilir
Technical Services

Introduction

The challenge with any power plant is how to raise its overall production efficiency for power generation by increasing availability, efficiency, throughput, safety, and environmental compliance.Our industry faces a rapidly evolving regulatory and market environment, so a long-term global perspective supported by a strong local presence is essential.

CBN, Mannvit & DTS engineers form a team of operation and maintenance experts with long-term experience in designing, building, operating and maintaining power plants all over the world. Together CBN, Mannvit & DTS have the presence, technology and
solutions to meet your power generation challenges as an efficient partner.
The lifecycle management approach redefines the concept power plant support.
We team up with our customers to improve the return on their assets while minimizing the lifetime environmental footprint of each process and the plant as a whole.

As we work to foster affordable, sustainable and secure energy solutions for society and our customers, we are continuously expanding the scope of our service portfolio to
embrace new technologies and equipment made by other manufacturers.

Operation and Maintenance Services

Qualified in all phases of power plant O & M necessary to achieve high availability, performance, profitability and safety

Our expertise includes:

- O & M estimation and budgeting
- O & M operation
- Startup and commissioning services
- Carried out by trained operators
- Developing and implementing formal startup and commissioning procedures
- Training, personnel policies and procedures
- Developing and implementing formal operating procedures and training programs.
- On site and off site training
- Long-term plant operation support
- Operating plants in a safe, compliant and efficient manner
- On site and off site plant operation support
- Maintenance management programs and support
- Developing and implementing formal procedural, maintenance, environmental and safety management programs
- Developing and implementing formal computerized maintenance strategy and software
- Installation, training and support on site and off site
- Power plant maintenance
- Steam turbine outage services and overhaul
- Rotors assessment and recommendation of scope of repairs
- Rotor repairs and spare parts supply
- Reverse engineering and 3D scanning
- Manufacturing new parts
- 3D engineering design
- Engineering and consulting services
- Inventory control/spare parts control
- Developing and implementing formal computerized strategy and software Inventory control/spare parts control
- Installation, training and support on site and off site
- Procurement services' spare parts
- Developing and implementing formal computerized strategy and software for procurement services' spare parts
- Installation, training and support on site and off site

Operator Responsibilities Training

After operation and maintenance training, operators will be equipped to take reasonable precautions for both their own safety and health as well as that of others who may be affected by their actions or omissions at work.

They will also be able to collaborate with their supervisors or other management personnel, as needed, to enable them to comply with their legal duties.

Operators will be ready to perform in an international environment as off-site support staff using modern communication devices.

Operators are responsible for maintaining and operating power plant components, ensuring safety, and optimizing plant output and availability. Additionally, they will be available for adjusting gauges and dials, reading temperatures, recording output and performing maintenance, as needed, in accordance with plant maintenance instructions.

Routine inspections by plant personnel ensure that all aspects and critical parameters for plant operations are continually monitored, components are operating normally, and that routine maintenance is being performed and recorded. The results of data collection and monitoring of parameters during routine inspections are utilized to identify and resolve problems, to improve plant operations, and to identify the need for maintenance. All personnel will be trained in routine inspections procedures relevant to their responsibilities.

Operation training encompasses start up, normal operation, emergency operation as well as the shutdown of plant components. Good operations are safe, reliable and economical. Operators and operator supervisors are specifically tasked with ensuring the safety and efficiency of operative components. The following rules should be adhered to foster excellent operations.

All operators must be thoroughly familiar with the components and systems they operate, and they must perform work assignments in a safe manner, in accordance with approved operating procedures. Operator responsibilities training will enable the operators to meet these essential demands.

The training includes learning:

- to study drawings, diagrams, instruction manuals, special operation procedures and emergency procedures
- to operate equipment and systems economically, safely and reliably.
- the location, method of operation and function of all valves, switches, electrical controls and other control devices
- to use available protective safety clothing and equipment.
- how to stay alert and focus on tasks in order to mitigate human error and avoid preventable situations
- to work as a team and that cooperation is of the essence when operating power plants

Primary Responsibilities

The duties of an operator include, but are not limited to:

Day to Day Duties

- To control and monitor steam systems, turbines, generators, and auxiliary equipment.
- To perform component checks at the beginning of each shift
- To observe gauges, dials, or other indicators to make sure components are working properly
- To check all steam traps routinely, twice a day at a minimum
- To perform routine maintenance on components and equipment and report to management if problems occur
- To distribute power among generators, regulate the output from several generators, monitor instruments to maintain voltage and regulate electricity flows from the plant
- To start and stop generators and to alter the amount of electricity output
- To detect and isolate malfunctioning equipment
- To operate and monitor equipment that increases or decreases voltage
- To operate switchboard levers to control the flow of electricity in and out of the substations

Safety

- To understand and act in accordance with the safety rules, safe working procedures and emergency response plan
- To make full use of the safety equipment and personal protective equipment provided, and to report any equipment defects to the management and/or supervisor immediately
- To provide feedback to the management and/or supervisor on the effectiveness of safety measures, safe working procedures and emergency response plans
- To report to the management and/or supervisor all hazards observed, defects identified or occupational accidents
- To maintain and operate power plant components, ensure safety, and optimize plant availability
- To prepare for emergencies or potential disasters

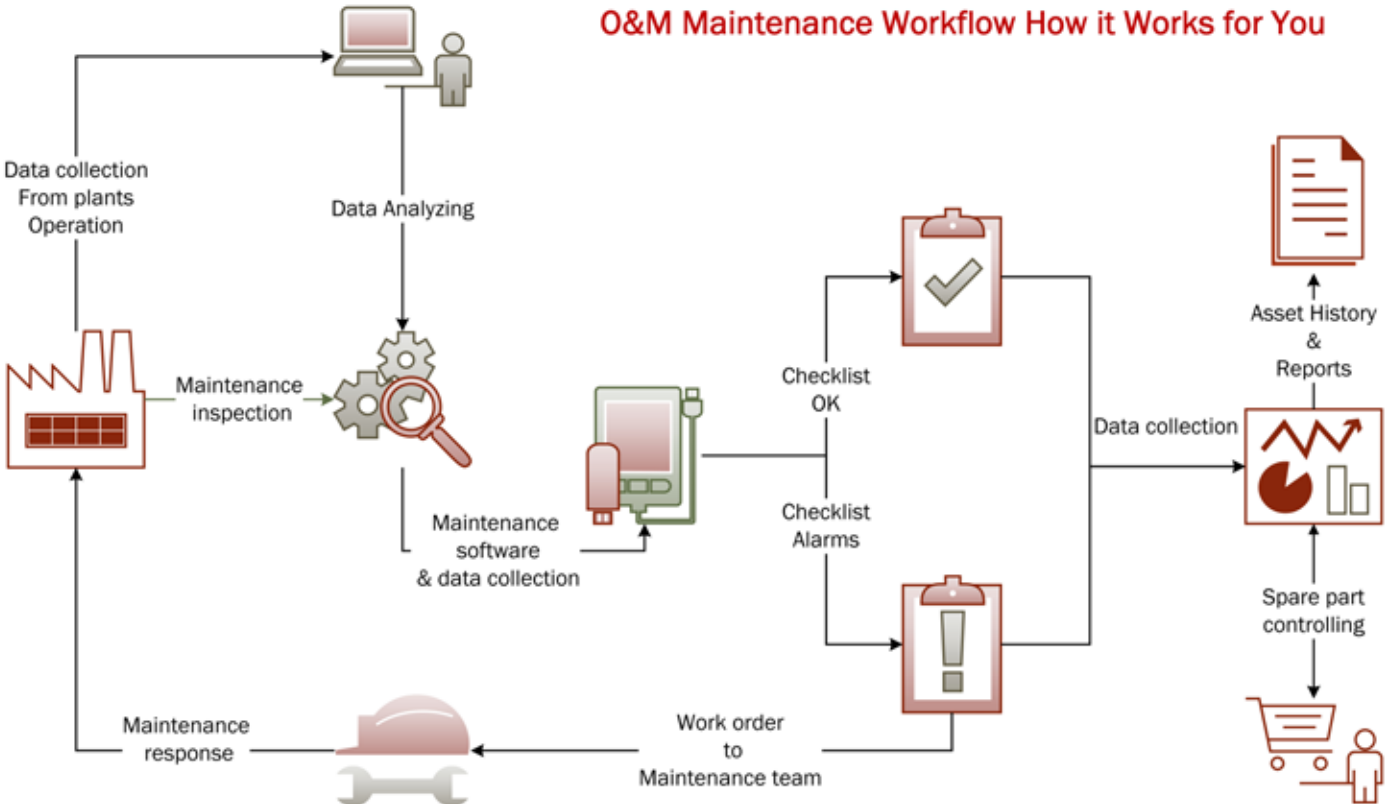
Maintenance management strategy

Over the lifetime of an asset, each failure will vary depending on the severity of the issue. Some issues will require a simple parts swap while others could take days to diagnose and repair. The frequency versus repair time plot follows a log-normal distribution. We will have a majority of repairs that are quick to repair, and a minority that take much longer.

Development of complicated turbine diaphragms, rotor and turbine casing rebuilding and repairs. 3D scanning and spare part manufacturing.

Planned, predictive and preventive maintenance is organized, well documented and entails scheduled repairs that address potential issues before any breakdowns even occur. The process of planning maintenance makes tasks more efficient and eliminates the downsides of maintenance on the operations of the plant.

Below is the common maintenance strategy as presented to each customer; jointly the best solution is always found based on what is needed. Note that some or all plans can be used in the same plant depending on redundancy and the importance of the parts to be maintained.



Reliability-centered maintenance (RCM)

Emerging from the realization that equipment failure probability is not linear, RCM is an in-depth, highly involved process that seeks to analyze all the possible failure modes for each piece of equipment, and customize a maintenance strategy for each individual machine.

The consensus is that RCM is too sophisticated a technique to be of much practical use. RCM is therefore reserved for an elite class of organizations that have already mastered the basics i.e. maintenance prevention, basic inspections and predictive maintenance.

Predictive maintenance (PdM)

PdM is a condition-based approach to asset management. Typically, monitoring equipment is linked to computerized maintenance software and generates work orders based on some meter reading (PSI, vibration analysis, widgets/hour) gathered by the monitoring device. It may also be simpler than this, such as by visual inspection from operators on the quality or speed at which the equipment is performing—for example, a conveyor drops below 1000 widgets per hour, triggering an inspection work order.

The advantage of PdM (over PM) is the potential for cost savings from reduced man-hours spent on maintenance, and more insight on performance and potential issues arising with machinery. For example, vibration analysis plus a visual inspection provides greater insight than visual inspection alone.

Preventative (scheduled) maintenance (PM)

This strategy is employed by most companies and almost all small to mid-sized companies make exclusive use of it. It consists of assets being taken offline, inspected at periodic, predetermined intervals and repaired if necessary. Although it's a relatively easy strategy to set up and execute, it can prove quite costly in the long run as most of the time these inspections do not result in any findings.

It's thus recommended that serious attention be given to the efficiency of the inspection schedules. For example, this can ideally be done in the form of an annual review of a given schedule in raising overall equipment effectiveness by preventing breakdowns and checking whether the schedule can be lengthened or swapped out for predictive maintenance.

Run to failure (breakdown maintenance)

This is an acceptable strategy for equipment that is of minimal importance to operations (rarely used or duplicates the function of some other equipment) or has a low cost. Take, for example, a $1000 belt feeder, whose lifetime value can be extended by 10% by servicing it every 3 months. How hard are you willing to work to save $100? For a non-critical piece of machinery, the answer should be "not hard."

Equipment designated as run-to-failure is fixed in the event of a breakdown (by repair, restoration or parts replacement) until it is more feasible to simply order replacement equipment.

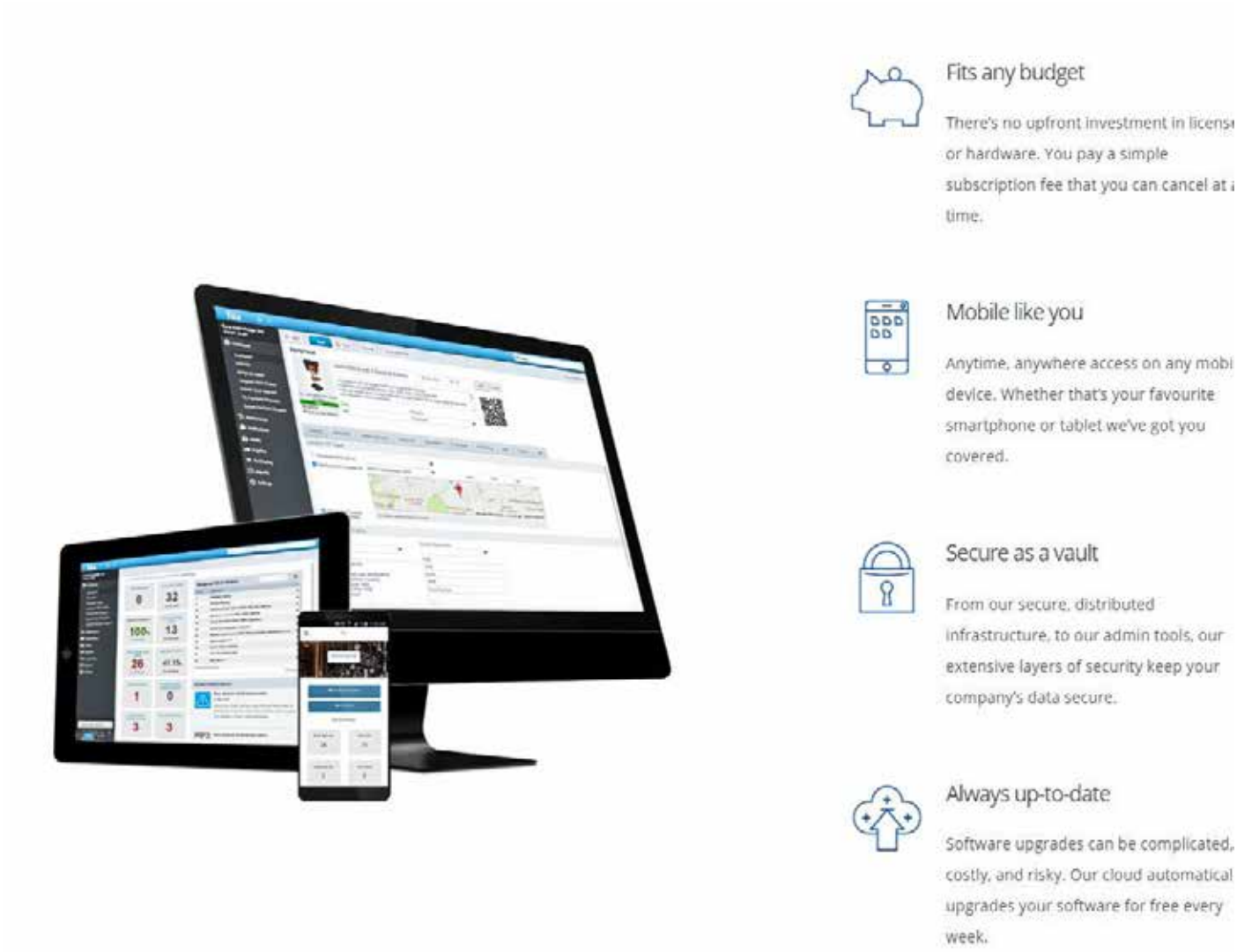
Maintenance program

DTS uses Computerized Maintenance Management Software to develop and implement formal procedures for maintenance, environmental and safety management.

We work both with commercially available software and our own proprietary software. Maintenance software is used to develop and implement formal procedures for maintenance, environmental and safety management.

CMMS packages may be used by any organization that must perform maintenance on equipment, assets and property. CMMS packages can produce status reports and documents giving details or summaries of maintenance activities. The more sophisticated the package, the more analysis capabilities that are available.

Many CMMS packages can be either web-based, meaning they are hosted by the company selling the product on the cloud, or LAN based, meaning that the company buying the software hosts the product on their own server.



Tracking work orders

Maintenance managers can select equipment with a problem, describe the problem, and assign a specific technician to do the work. When the machine is fixed, the responsible technician marks the work-order “complete” and the manager gets notified that the work is done.

Scheduling tasks

As a team starts to schedule preventive maintenance, they need a reliable work calendar. CMMS systems are especially good at scheduling recurring work and sending reminders to the right people. Organized scheduling helps even out the workload for a maintenance team making sure that tasks do not get forgotten.

External work requests

Maintenance teams often must accept a work request from people outside the team. This can be a request from an assembly line operator who is hearing a strange noise from a drill or a tenant at an apartment building who is requesting shower repairs. The CMMS is a central place for recording these requests and tracking their completion.

Recording asset history

Many maintenance teams have to care for assets that are 10, 20, even 30 years old. These machines have a long history of repairs. When a problem comes up, it is always useful to see how this problem was solved last time. In CMMS systems, when repairs are done, they are recorded in the machine’s history log and can be viewed again by workers. It is also useful for root cause analysis.

Managing inventory

Maintenance teams must store and manage a lot of inventory that include things like spare parts for machines and supplies like oil and grease. CMMS systems let the team see how many items are in storage, how many were used in repairs, and when new ones need to be ordered.

Audit and certification

Many CMMS systems keep an unchangeable record of every action, so an asset’s maintenance history can be audited. This is useful in case of an accident or insurance claim–an inspector can verify if the proper maintenance was completed on a machine. CMMS systems also keep data in a centralized system, which helps keep one version of the truth for ISO certification.

Benefits of a CMMS system

When you implement a computerized maintenance management system, you can expect to see these benefits:

Less work outages:

It is easy to do preventive maintenance which means there are less surprise breakdowns.

Better accountability:

Quickly see if a technician did their work on time and get alerted when a task is complete.

Less overtime:

Better scheduling of work means that your team isn't sitting idle or working overtime which means work can be distributed evenly.

Information capture:

Technicians can record problems and solutions, so this information is recorded for others to use.

Savings on purchases:

Inventory planning features give you the time to shop around for spare parts pricing, instead of having to buy in a hurry.

Certification analysis

A full record of assets and performance helps managers analyze energy usage, plan maintenance and spend accordingly.

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