Whitepaper

A holistic approach to optimising efficiency in coal fired power plants

Phil Burge, Communication Manager for SKF, looks at coal plant maintenance, introduces the latest disciplines and explains how these can be applied in real-world applications in the power sector to optimise equipment performance and reduce unplanned shutdowns.

The four phases of maintenance maturity.
Moving toward a world-class facility starts with understanding where you stand today, and defining your objectives for the future.

Strong economic growth, increases in income per capita, leading to improved standards of living, rising consumer demand for lighting and appliances, and growing requirements for electricity in the industrial sector, all translate to a rapidly growing demand for power generation. Indeed, research conducted in the US has estimated that world net electricity generation will increase by 77%, from 18.0 trillion kilowatt-hours in 2006 to 23.2 trillion kilowatt-hours in 2015 and to 31.8 trillion kilowatt-hours in 2030, increasing by an average of 2.4% each year.

Despite recent figures indicating a strong move towards low carbon technologies – indeed **global wind power generation alone grew by 31% in 2009** – traditional methods, namely coal, remains the backbone of European electric generation, normally accounting for well over half of all new power production capacity. In particular, coal continues to fuel the largest share of worldwide electric power production by a wide margin. In 2006, coal-fired power generation accounted for 41% of the world's electricity supply; in 2030, its share is projected to be 43%. Sustained high prices for oil and natural gas make coal power generation more attractive economically, particularly in nations that are rich in coal resources, such as China, India and the United States.

For existing coal-fired power plants, the ability to meet this challenge is often made more trying because of aging equipment and the ongoing loss of their most experienced personnel. For new plants, profitability hinges on the implementation of information sharing technologies that make it possible to keep manpower at a minimum without added risk to plant assets or personnel. Ultimately, to meet the rising demand for power while remaining profitable, coal fired power facilities need to exploit every opportunity for greater machine reliability and process efficiency. This need to maintain productivity and profitability means that operating equipment, from turbines and generating sets to coal yard conveyors and handling systems, have to work under typically extreme conditions and to do so reliably for long periods with minimal maintenance. In addition, components are often subject to heavy loads and high temperatures, abrasive dust, dirt and moisture.

Effective plant maintenance is, therefore, one of the areas that must be addressed in order to increase production, reduce downtime, extend machine life, improve the performance of critical equipment, enhance safety and lower operating costs.

At one time, it was common practice to wait for equipment to fail before repairs were carried out. However, decision makers within the coal fired power sector quickly came to realise that in order to guarantee continuous production and prevent any disruption to supply, an alternative, more efficient approach was needed.

Then came preventative and predictive maintenance programmes, which were used to identify and to some extent prevent imminent failures in order to enable smoother operation and help avoid any major economic and environmental repercussions. This shift in thinking spawned a new generation of diagnostic tools and software, such as integrated and intelligent vibration and thermal sensors and accelerometers, designed to allow plant engineers to forward plan shutdown and repair. However, although predictive maintenance is now a common strategy it remains largely a reactive process that, in today's highly competitive global economy, adds little to a company's bottom line. Ultimately, what is needed is a holistic approach that optimises the efficiency of plant and equipment, by proactively managing both system reliability and risk assessment across an entire organisation.

One emerging strategy is known as Asset Efficiency Optimisation (AEO), which has been developed as a tool to improve plant productivity and thus profitability. In practice, this approach is proving to be highly effective. For example, one utility that adopted an AEO strategy, in place of periodical maintenance or fixed interval maintenance, was able to realise a reduction in forced outage rates by 30%, with a 7% increase in peak period availability.

Essentially, AEO creates a dynamic programme that combines the advantages of traditional techniques with procedures that identify the root causes of machine and process problems, and empower front line operators to own their machinery, identifying and communicating information to a plant wide team to maximise uptime.

However, for any integrated reliability and risk based asset management strategy to be effective, thorough planning prior to its implementation is vital. The first step in developing the programme is typically a detailed Client Needs Analysis (CNA), where maintenance managers and engineers ask key staff the right questions to gain a snapshot of the current maintenance strategy and its efficiency in order to draw useful and accurate conclusions that can be built upon. The CNA process uses a sequence of assessment questions from each of the four main facets of the AEO process to focus on improving processes, culture and technology.

Using the information gathered from the CNA, a detailed roadmap can then be established in order to achieve optimum performance from the maintenance department. This information will help to identify and target necessary and viable areas for improvement that can be worked on under the four elements of an AEO programme: maintenance strategy, work identification, work control and work execution.

Maintenance strategy is the stage at which a business sets out its larger goals and objectives, assesses plant criticality and risk, and decides what the most important issues and priorities are. This forms the foundations for a suitable and effective maintenance plan to be created, and sets in place a recognised and auditable company asset management strategy, which can be easily communicated throughout the organisation.

This information is then used in the second stage, work identification, where critical plant data is gathered and analysed, allowing informed decisions to be made and the corrective maintenance operations to be carried out. At this stage an industrial Decision Support System (iDSS), such as SKF's @ptitude system can provide valuable support to senior maintenance engineers, by making relevant condition based maintenance recommendations available online, as well as providing access to a wealth of specific and expert knowledge on asset maintenance. Work requests are then submitted to a Computerised Maintenance Management Systems (CMMS), to be combined with other predetermined planned and corrective maintenance activities.

The third stage, work control, relies heavily on the priorities and structure determined during stages one and two, allowing maintenance activity to be planned in detail and scheduled with tasks prioritised, taking into account timescales, man hours required, data feedback, and competence requirements. Effective planning at this stage, combined with good spares management, well-defined job plans and trained staff, allows resources to be utilised in the most efficient and productive way.

With these three components fully completed, the final stage, work execution, can be implemented, with detailed plans put into action and maintenance work carried out. It is crucial that feedback is collected via post maintenance testing in order for continuous improvement to be maintained and maximum return on investment to be achieved.

Another innovative approach is the Integrated Equipment Reliability (IER) programme from SKF, which has been specifically tailored to meet the needs of coal fired power plants. Similar to AEO, this programme provides a flexible framework that allows maintenance to be planned and carried out more efficiently in order to cut costs and increase the availability and safety of equipment. Based on a best practice predictive maintenance strategy, IER complements and accommodates a plant's pre-existing programmes and systems, and can incorporate operator drive reliability processes and technology for the early detection and correction of machine problems.

The IER programme has been designed to make it easy to define the maintenance tasks that need to be carried out on which machines and when using minimal plant resources. This approach also allows management to analyse personnel safety hazards in line with the latest health and safety regulations, as well as highlighting environmental risks, ensuring the plant operates safely, legally and responsibly.

At the foundation of this strategy is a range of software programmes, such as SKF's @ptitude Decision Support System, which enables managers and maintenance engineers to input vital information including tasks, frequencies and job plans into the plant's central systems. This software can also produce bills of materials, spares lists and other useful data that is needed to ensure optimum efficiency in work planning and scheduling.

Through the use of this latest generation of integrated, holistic approaches to coal fired power plant maintenance, companies can not only eliminate many of the problems associated with unexpected downtime and high maintenance levels but also realise an increase in Mean Time Between Failures (MTBF) and a significantly lower cost of ownership. Perhaps most importantly, an effective strategy will enable these companies to minimise costs and achieve consistently high levels of productivity and profitability.

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