TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical | Fertilizer | Chemical | Refinery | Engineering | Automobile

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Knowledge-Based Life Management Of Steam Generators (Boilers)

An insight.

All plants are susceptible to ageing, and so are automatically subjected to the risks of mechanical integrity failure such as loss of containment. Given this, plant operators should be taking action to manage their ageing plants, but at the same time all companies need more output for less input; higher production and less investment, higher reliability but lower maintenance. Knowledge Based Inspection (KBI) may be a solution in effectively managing ageing plant and achieving that aspiration of higher productivity through less down time.

Boilers represent a significant capital investment for any company, making routine inspections all the more necessary for proper operation and to help reduce the chance of accidents. Preventative action can decrease boiler risks and lower liability insurance costs at the same time. KBI is about inspection of the plant in a manner which is bespoke to its needs, and finding the correct and most efficient inspection regime. This can remove the need for unnecessary and costly inspections.

Expanding technology for boiler installations has brought with it greater boiler complexity. More automatic "watchdogs" such as electronic monitoring devices and other control components are now used to improve operation. However, too often these automatic features lead plant personnel to become complacent and mistakenly assume it's safe to ignore the equipment.

Pressure parts are the largest cause of lost generation in coal-fired thermal power plants. Forced outages due to pressure part failures, mainly tube leaks, account for about 23% of lost generation. (NERC, 2012). Pressure parts are also likely to be a dominant maintenance item in the planned boiler outages which account for 39% of lost generation.

One critical step toward boiler safety and optimum performance is conducting a boiler inspection either annually or every six months, depending upon the type, style, size and age of the boilers. This simple procedure helps one to spot possible trouble areas, reduce downtime and prevent harm to personnel and equipment.

A boiler inspection is routinely handled by an independent

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- Completed RLA of 15 boilers in the month of September at various plant locations in the country.
- Carried out Reformer Tube Inspection by Automated Reformer Tube Inspection (ARTiS) at premier fertilizer plants and refineries of the country. More than 700 reformer tubes were scanned for their integrity assessment.
- More than 600 on-site microstructure interpretations were done in the last month at various power and petrochemical plants.

EVOLVE by TCR

- Evolve has planned training courses on "Heat Exchanger Inspection" and an innovative hands-on training workshop on "Scanning Electron Microscopy" in mid-November.
- Installed new UTM machine with 10kN capacity. This machine will be utilized for fine wires, foils, thin sheets, Rubber and plastic testing. The machine is also capable for testing of small size springs.

10 kN UTM

technical specialist. This inspector checks out areas that affect the boiler's structural integrity. Qualified plant personnel with working knowledge of the boiler can perform a general inspection and spot trouble areas long before an outside technical specialist is required to be called. KBI facilitates development of such an internal expert system in the plant without seeking the services of outside specialists.

Knowledge Based Approach integrates available knowledge and experience about client's facility and also certain safety criteria into a rational framework. That framework will ensure that the client's safety criteria are met while it helps him to optimally schedule and plan major maintenance activities.

Based on the risk assessment of boiler pressure parts, KBI can create an optimized maintenance strategy integrating Time-Based Maintenance (TBM), Condition-Based Maintenance (CBM) and Breakdown Maintenance (BM). In order to improve the maintenance management, ensure the stable operation and reduce the losses due to over or less maintenance, KBI system can be set up and applied to equipment maintenance in Thermal Power Plants. Based on the risk analysis theory and RBM process, the new maintenance strategy can be established after the risk assessment of few individual units. According to the statistical data for new maintenance strategy the percent of different maintenance methods can be changed, some transferring from time-based maintenance to condition-based maintenance, some extending their maintenance cycle.

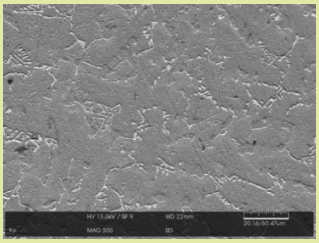
The main view point adopted by the operators of coal-fired boilers considers two critical issues in operation: finances and failures. Knowledge-based life management permits an assessment of both financial and technical issues and is claimed to be the best-practice approach to asset management. The practical problem is that knowledge-based methods are data-hungry and call for extensive data to be collected and analyzed.

Qualitative risk assessment allows for a relatively, quick overview to rank plant equipment components on the basis of likelihood of failure and consequences of failure which are then presented in a risk matrix to identify clearly the priorities. **Knowledge-Based Inspection (KBI)** is an analysis methodology and process that, as opposed to condition-based inspection, requires qualitative or quantitative assessment of the **Probability of Failure (PoF)** and the **Consequence of Failure (CoF)** associated with each Steam Generator (Boiler), critical piping circuits included, in a particular coal-based thermal power plant. A properly-implemented KBI program categorizes individual pieces of equipment by their risks and prioritizes inspection efforts based on this categorization. A multidisciplinary team is used including Inspection (Quality Control), Maintenance, Production, Process, Metallurgy and Mechanical Design to consider all relevant technical data in a highly structured manner, The aim is to identify all potential failure mechanisms acting on each component or node of equipment and to assign LIKELIHOOD & SEVERITY categories. The quantitative approach involves detailed assessments of the likelihood and consequences of failure of each plant item, where failure comprises small, medium or large loss of containment, or complete rupture. Likelihood of failure is evaluated from generic equipment failure frequency data when available, modified to take account of equipment age, condition, complexity, process conditions, modes of degradation and rates of deterioration etc.

KBI is used to identify and understand risk, risk drivers, and where equipment is in its lifecycle. KBI can indicate whether inspection is needed or not. However, this requires additional data that is extremely targeted to reduce the underlying uncertainties associated with the risks about the current and future predicted damage state of the equipment. KBI should not be used to recommend any inspection if it does not improve knowledge about the damage state. In those cases, where PoF is driving the risk, KBI should point to other mitigation options such as replacement, repair, or other actions that satisfy the risk criteria.

KBI can be used to prioritize inspection-related activities, usually by means of Non-Destructive Testing (NDT), in order to reduce the uncertainties around the true damage state of the equipment and the dynamics leading to such. The resulting inspection plan may outline the type and scheduling of inspection for an asset. In addition to NDE, additional risk mitigation activities identified by a KBI assessment in a process plant might include a change in material of construction, installation of corrosion resistant liners, operating condition changes, injection of corrosion inhibition chemicals, etc.

Consistency and repeatability of analysis are critical to producing an effective KBI program, as KBI is based on relative risks. Caution should be used when mixing KBI platforms (e.g., using a qualitative method to perform the initial screening and quantitative methods to conduct the final analysis). Complementary methodologies must be calibrated against one another to ensure that valid cut sets are achieved.



Microstructure of the Month

Magnification: *2000X*
MOC: Cobalt Base Alloy
Component: Impeller(Vane)
Etchant : Glyce-regia
Observation: Microstructure shows fine precipitates in the dendritic γ solid solution matrix. Fine precipitates along with Cr23C6 eutectic carbides are seen in the microstructure.

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