Minutes of Meeting

VGB-Technical Committee: **Generation and Technology**

VGB-Working Panel: **PGMON**

Power Generation Maintenance Optimisation Network

39th Meeting on 14./15. 9. 2009 in Lippendorf

Agenda

Welcome (Paul Thame)

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Claude Degrave, EDF

TOP 2: Review of safety incidents during maintenance activities
Paul Thame, EON UK

TOP 3: Generator replacement based on reliability calculations
Henk Wels, NRG

TOP 4: Castings from China
Heinrich Grimmelt, VGB

TOP 5: Asset management for fossil-fired power plants: methodology and an example of application
Ludovic Benetrix, EDF

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Ladislav Ullmann, CEZ

TOP 7: On-line monitoring of control valves
Willy Vanderelst, Laborelec

TOP 8: On-Load Loss Analysis
Dr. Lynne Jilbert, RWE Npower

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TOP 1: Equipment Reliability Process
Claude Degrave, EDF

Since 1995, EDF used a RCM approach for helping to define and to optimize the preventive maintenance programmes for its fleet, but the need for Improving the Equipment reliability Process appeared necessary for several reasons, such as to speed up the Experince Feedback loop, to provide plant staff with more convenient and simple tools as an efficient Information system software.
Taking benefit of the experience from other utilities, particularly in the US, EDF decided in 2008 to adopt and implement the AP 913 process developed in 2001 on the behalf of the Institute of Nuclear Power Operators (INPO) to improved equipments reliability.
The principle of this process is to adapt the maintenance and the monitoring of each equipment considering its criticality (impact of its failure on the safety and availability of the unit).
The key issues of the AP913 are : improvement of safety and availability, follow-up of systems and equipments, reliability management, reactive processing of the operation feedback and an efficient information system in support.
The implementation of the process starts with the classification of the structures systems and components regarding their criticality and with the development of templates giving the generic maintenance programme for a family of components which will be completed at the end of 2010.
The coporate and sites Organization (including the Information System) will be fully operational in 2012.
The main expected benefits are a decrease of forced outages and a reduction of corrective maintenance activities.

The presentation can be found in the closed user group.

TOP 2: Review of safety incidents during maintenance activities
Paul Thame, EON UK

Optimised maintenance cannot only be based on economics: the working procedures must be safe for maintenance personnel. Unsafe working practices or maintenance procedures can result in fatal accidents. The people who maintain vital electricity assets must not be killed by their work and employers or contract managers have a responsibility to ensure personnel safety on their sites.

To help understand the causes of fatal accidents, information on as many incidents as possible was collected from internet media and literature sources from any power company, anywhere in the world. Accident data was restricted to conventional power generation (no nuclear) and only those incidents where maintenance activity contributed to the cause. There were 56 fatal incidents, 89 dead workers.

It was found that the most common type of incident was fall from height. Whilst the most frequent incident type by a long way, it normally resulted in a single victim. Causing nearly as many fatalities but fewer incidents were fuel / chemical explosions and electrical blasts (switchgear and transformers). These incidents resulted in approximately three victims per incident on average. Other significant contributors to fatalities included fire and contact with moving machinery.

To avoid safety incidents during maintenance, work needs to be planned carefully, hazards should be identified in advance and risks controlled. Maintenance workers need to be well trained and aware, guided by a good safety culture.

The presentation can be found in the closed user group.

TOP 3: Generator replacement based on reliability calculations
Henk Wels, NRG

A utility suffered a conductor short current in a generator at a power plant. Since this generator and three identical generators are over 35 years old, the utility asked for an analysis of spare stators and rotors for these generators. The analysis was carried out by a set of qualitative and quantitative steps:

- A short Failure Mode & Effect Analysis for generator failures
- Analysis of the VGB generator database and data from the VGB forced unavailability database KISSY
- Analysis of literature on Weibull coefficients for electrical machines
- Simulation of the frequency of occurence and forced unavailability with and without spare parts

The results of the analysis were incorporated in a Life Cycle Cost model for the power plant under consideration.

The presentation can be found in the closed user group.

TOP 4 Castings from China
Heinrich Grimmelt, VGB

In the course of quality supervision for an operator it was observed that non return flaps of SCV type manufactured by Company Adams, Germany, were afflicted with cracks.
All casings which had been delivered by a chinese company and were in the process of manufacturing have been carefully checked and repaired if necessary.
Together with Adams and other specialists VGB will create a classify catalogue for the casings depending on steam parameters and operating regime. With this catalogue the operators may take adequate action to prevent danger.

The presentation can be found in the closed user group.

TOP 5: Asset management for fossil-fired power plants: methodology and an example of application
Ludovic Benetrix, EDF

This presentation coped with « Durability method » developped by EDF so as to manage its industrial assets. This method was first developped for the nuclear fleet but is now also applied for the fossil fired fleet. First the overall industrial context was reminded : particularities of the French energy mix that strongly relies on nuclear generation, deregulation of the utility market and evolution of air emission standards. This context thus creates new needs for asset management methods and tools.

The Durability method was then described. This is a multi-level approach allowing to deal with both component and fleet level issues. In addition a probabilistic approach is used which allows a convenient consideration of the various uncertainties related to the fleet (emission standards, ageing and degradation of the components).
An example of application was finally presented for the three EDF 600 MW coal fired power plants. This fleet was studied because the plants are expected to be operated up to around 2030 thanks to the recent installation of new pollution control systems. For a given component of the

steam turbine exposed to a risk of failure the opportunity to make a preventive acquisition of a spare part was compared to a basic corrective scenario. The economic indicators (among which the net present value is the most frequently used) and their probability distribution functions were estimated through Monte-Carlo simulations and showed that the preventive scenario is economically profitable despite the high initial cost due to the preventive acquisition of the spare part.
The next step of the study consists in studying other major components (boiler, condenser, generator) and then in performing an overall fleet optimization taking into account the regulatory issues.

The presentation can be found in the closed user group.

TOP 6: Project Assessment Methodology in ČEZ
Ladislav Ullmann, CEZ

ČEZ operates a portfolio of coal power stations, two nuclear power plants and cascade of smaller hydro power plants located on the river of Vltava. To improve the efficiency of the power emergency ČEZ finds necessary to interpret the duty of each plant into the maintenance policy. The aim is to incorporate different data sources and approaches and interpret them as a guide to decision making process. The system consists of identification of group of power plants of similar operating mode and their production parameters and based on to tailor the approach to the plant maintenance. System evaluates requirements for technology maintenance from the point view of safety, economy as well as risks brought by equipment failure to people's health, environment, generation availability and possible chain damage to the equipment. The system is incorporated into a project management SW.

The presentation can be found in the closed user group.

TOP 7: On-line monitoring of control valves
Willy Vanderelst, Laborelec

What can one expect from a control valve?
One should expect a stable behavior in her control loop AND the valve must be reliable. This applies to both the actuator and the valve as a mechanical component.

The I&C technicians observe that the control behavior is often disturbed due to:
- Bad choice of control structures or PID control parameters (20 %)
- Change in operating conditions (20 %) -> e.g. rapid load changes, participation in grid frequency control, fuel switching, …
- **Problems of the valve or its actuator (60 %)**

The project leader who must prepare a revision is faced to the question: which valves must get an overhaul?
So the maintenance approach must be multi-disciplinary; either I&C technicians, electricians and mechanics could be involved.

By what means can one have at his disposal the necessary information to decide on which valve should and which shouldn't have an overhaul?
Control valve on-line monitoring can bring the necessary info to answer this non trivial items:

- The comparison between valve position set point and the measured position -> shows the presence of dead time, hard points and hysteresis. Also control parameters as settling time, rise time, overshoot and undershoot can be determined.
- The graph of valves position towards flow can show the valves Kv or at least the process characteristic. So the following questions must get an answer:
  - Is the characteristic linearity acceptable?
  - Is there no leakage flow when valve position is zero?
- The time in function of position can give an estimation for the total travel time -> gives indication on presence of friction or actuator problem
- A position histogram can indicated if the valve Kv dimensioning is too big or too small
- The total travel time and number of opening and closing commands can be calculated and gives valuable information to the maintenance staff
- The number of times the torque limiters and position end switches where active
- …

The monitoring system makes use of existing measurements and data logging system.

Today’s valves suppliers do not offer a generic solution that can cover the monitoring of a hybrid control valve park in a power plant.
For this reason Laborelec/Electrabel developed in collaboration with a partner for software development, a dedicated monitoring tool. This tool was tested, first in a simulated test set-up and after that in real conditions on site. The results are good but implementation on larger scale needs further investigation and development efforts.
During the further development of the tool, investigation about the integration of Smart Signal Early fault detection, within this tool will be done.

The presentation can be found in the closed user group.

TOP 8: On-Load Loss Analysis
Dr. Lynne Jilbert, RWE Npower

On-load losses can be defined as availability losses or restrictions that limit the plant's output whilst on-load or generating. In the UK the definition only applies to those losses where it would have been otherwise economic to generate. On-load losses are often overlooked as operators focus on downtime events due to breakdown, but can account for a significant proportion of lost availability. Typical current levels for our coal portfolio are of the order of 3.5% with individual units peaking at 6%, and recent trends show the prevailing trend to be increasing. Analysis of the causes of these losses indicates emissions, fuel quality and milling / feeder issues to be the main contributors. The underlying cause of these issues is thought to be ageing plant in combination with tightening legislation and a broadening of the coal diet.

On-load losses for gas-fired CCGT plant are more difficult to analyse. The predominant factor influencing daily capability re-declarations is ambient conditions although we believe other causes are often masked by this as restrictions are included in the daily ambient declaration of capability. Another complication is for multi-shaft configurations when a breakdown on one shaft-line is recorded incorrectly as an on-load loss as the rest of the plant is still generating - these cases need to be removed from the on-load loss analysis. Taking these factors into account, CCGT on-load losses typically account for about 1% of economic generation.

TOP 9: Small conference on reliability & maintenance optimisation of power plants

- The scope of the conference should cover the same subjects as PGMON.
- We should issue a call for papers.
- Target date is Autumn 2010 and the conference should be instead of PGMON.
- The conference should last 1 day and PGMON may meet the day before for planning etc.
- Henk will lead the planning.
- Action: Henk to write a proposal and plan describing objectives, how the conference will be organised, what resources are required, who will provide resources, how are PGMON members expected to contribute. This should be sent to PGMON members for comment.

TOP 10: Place and date of next venue

The next meeting will be held on 24./25. March 2010 in Prag.

Essen, October 2009