Minutes of Meeting

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

VGB-Working Panel: **PGMON**

Power Generation Maintenance Optimisation Network

36th Meeting on 27./28. 3. 2008 in Lyon

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TOP 1: Modelling of degradation mechanism of hydropower generators
Antoine Despujols, EDF

The EDF French hydroelectric fleet which represents an installed capacity of approximately 20 GW, is old (average age higher than 50 years) and diversified (more than 500 power stations). The maintenance of its current performances and the management of the asset value require the knowledge of the equipment actual state so as to envisage the necessary restorations and renovations. That requires to define indicators which will make it possible to determine the actions to undertake and to assess the future costs.
EDF R&D works on a method, applied to the case of the generators, which started with an FMEA analysis carried out by a group of experts. This first step resulted in establishing the dreaded degradation mechanisms, their influencing factors, their symptoms, failure modes, consequences, and the applicable preventive maintenance actions.
On this base Bayesian network technique is used to represent the interactions between all the elements listed in the FMEA and to calculate the probabilities of the degradations to be at a given level (low, mean, high) depending on the current symptoms and the past influencing factors and causes (e.g. operating hours, environment, maintenance tasks carried out, etc…). The possible influences between the degradations mechanisms are also considered. A modelling has been carried out for the stator of a generator taking into account six critical degradation mechanisms. Simulation was undertaken to assess to actual state of some particular generators.
This study is still in progress in order to complete the generator modelling. It should be used to help decision making to prioritise the generators to be restored.

The presentation can be found in the closed user group.

TOP 2: Presentation of CNR
Christophe Turbidi, CNR

CNR was created in 1933, and entrusted by the French government the concession of the Rhône in 1934. It is a “société anonyme” (limited Cie) with general interest. It is an independent electricity producer that has marketed its energy since April 2001.
The company manages 18 barrages, 1 dam, 19 hydropower plants (3000 MW) and 14 wide gauge locks on the river.
The Company's capital is composed of mostly public shareholders and a private partner, the company Electrabel (Suez group) who onws 49.97%.

The presentation can be found in the closed user group.

TOP 3: Return of experience on Wind turbines
Yves DeMulder, Laborelec

Today, Electrabel already has more than 5,500 megawatts (MW) of capacity generated from renewable sources, of which 655 MW comes from wind farms in Belgium, France, Portugal, the Netherlands and Italy.
Due to the huge demand, wind turbines are developed and produced at high speed, which might have some consequences for the end users. Together with the fact that they represent a very large number of rather small power islands, generally hard to access, managing the follow-up and maintenance of them needs a high dose of creativity.

Therefor users should share their experiences as much as possible, about the wind turbines themselves as about the manufacturers. The presentation deals with 3 main issues: oil problems, ice fall and generator failures.

The presentation can be found in the closed user group.

TOP 4 Engineering risk management
Paul Thame, EON UK

Most of the coal fired generating units in Britain are now 35 – 40 years old and there is increasing concentration on serious failures that pose a threat to personnel safety. Some incidents have caused concern in recent years, especially failures of boiler pressure parts and civil structures. To ensure that safety levels do not deteriorate, the UK fossil generating companies are collaborating in a national programme called GENSIP, the Generators Safety and Integrity Programme. In addition to knowledge sharing, GENSIP working groups are actively working to identify credible hazardous plant incidents, assess priorities and propose development projects that will improve safety management. The GENSIP programme will result in a series of Good Practice Guides for ageing coal fired plant.
In addition, E.ON UK have launched in-house initiatives to manage the safety risk of generating plant failure, centred on a special project called ERMR (Engineering Risk Management Review). This will ensure that the best processes and procedures are in place to maintain a safe place of work.

The presentation can be found in the closed user group.

TOP 5: Experience with NON OEMS for Gas Turbines
Henning Lundstrom, Vattenfall

The presentation stated the principles of using non OEM suppliers for the Vattenfall Power stations in Denmark.

The Danish power stations have a long tradition of using many local companies for more reasons, but mainly to have access to quick assistance in alert situations and also to create a competition between the OEM and the non OEM companies.

By using the non OEM companies one must be prepare to counter actions from the OEM companies including their unwillingness to assist you.

Vattenfall in Denmark has obtained good prices for many non OEM suppliers and especially the recoating of gas turbines blades are emphasizes.

But it wasn’t a success with the reverse engineering from a non OEM supplier for the very complex first row blades for gas turbines.

A result of the discussion at the PGMON meeting was that you must be very much aware of the extent of complexity when ordering reverse engineering products from a non OEM. The very complex first row blade in a gas turbine is obviously close to the limit.

The presentation can be found in the closed user group.

TOP 6: Operational Risk Review of a 60 MW Boiler
Richard Sheehan, John McManus, ESB

Following a number of leaks in a 60MW boiler in late 2007, Power Generation commissioned a risk review to assess the current condition of the boiler and identify what measures, if any, were needed to ensure the continued safe operation of the boiler for its short remaining economic life.

The review involved a comprehensive assessment of the condition of the boiler, including identifying potential failure mechanisms, the likelihood and consequence of such failures and the identification of any additional control measures. The review also necessitated engineering calculations to ensure that the control measures were in line with acceptable practice.

To ensure continued safe operation of the boiler up to its planned closure date, the review recommended: -

- The completion of a detailed inspection program and any recommended repairs arising from this program.
- The introduction of a 6m exclusion zone from the furnace wall when the boiler pressure is above 20 bar pressure. A complete exclusion zone to the burner deck levels and above the operating floor level around the boiler once the pressure is above 20 bar.
- The introduction of cameras, possible remote operation of specific manual valves and the introduction of additional Standard Operating Procedures to facilitate safe operation of the plant when the exclusion zone is in place.

The threshold pressure of 20 bar at which the exclusion zone comes into operation is conservative and may be reviewed into the future.

The presentation to PGMON outlined the approach taken by ESB Power Generation to carry out the above risk review.

The presentation can be found in the closed user group.

TOP 7: Sampling maintenance
Celia Domecq, EDF

The existence of similar equipment which are identically maintained and operated makes possible to constitute homogeneous technical equipment families. The selection and the thorough control of a reduced number of pilot equipment within these families, can in certain cases replace the overhaul inspections which should have been carried out on the totality of the equipment. EDF has implemented this innovative condition-based maintenance strategy on its nuclear fleet. To help the implementation of this strategy of preventive maintenance, EDF R&D has developed a method to choose the pilot equipment in order to control the risk of failure on the equipment which are inspected. This method allows, according the case:

- to qualitatively choose (on the basis of expert knowledge) the pilot equipment by a deterministic method;
- to quantitatively fix the pilot equipment sample size, by a statistical method.

This maintenance strategy has been implemented on about 17 equipment families on the nuclear plants fleet of EDF, particularly on stand-by rotating machines, valves and electrical components.

The presentation can be found in the closed user group.

TOP 8: Assessment of Start Reliability for the UK Generation Fleet
Dr. Lynn Gilbert, RWE npower

In response to commercially volatile market conditions requiring an increased level of plant flexibility, a study was carried out to try and assess what level of flexibilty the UK generation fleet was delivering andhow reliably. Data for expected and metered generation, and plant availability for all large UK generating plant is publicly available and was collected for analysis for all coal-fired and CCGT plant. 'Start Reliability' was analysed by evaluating the lost MWh for a fixed period of time following an instructed start. Logic was applied to the half-hourly generation and availability data to first determine the number of starts each plant had undertaken, and then for each start evaluate the lost MWh from the difference between expected and metered generation. The results show that the higher the number of starts undertaken per year, the lower the MWh lost in the period immediately following a start; i.e. the better the start reliability. Examination of the loss trends show typically start-up losses are mostly incurred in the 3-4 hours following an instructed start. These are due to a combination of delayed starts and slower ramping.

When examining the relationship between the number of starts and the overall plant availability, the expected link between more frequent starts and lower availability (due to increased plant degradation) could not be demonstrated from this data. Further information on planned and unplanned availability could be used to demonstrate any link with increasing breakdown rates or changes in the inspection & overhaul programme.

Lastly, the data showed a link between number of starts and utilisation. Plant undertaking a higher number of starts per year generally had lower utilisation, indicating that they switched off when out of cost and restarted more to capture the best market conditions. This demonstrates the increasing commercial requirement to be more flexible in the UK wholesale electricty market.

The presentation can be found in the closed user group.

TOP 9: LTSA experiences
Henk Wels, NRG

In the Netherlands a 1200 MW coal gasification (syngas) plant will be build and equipped with advanced gasturbines. Now, the maintenance costs for any advanced gasturbine must be analysed with regard to dominant parts, RAM targets, reconditioning versus new, scrap rate, responsibilities, etc. An electricity company can choose between LTSA with a firm or Spare Parts only in combination with carrying out maintenance by its own employees AND all intermediate contract forms.

One way to assist in the decision making is a comparison with other contracts for CC within the utility. As contracts differ in scope, duration, responsibilities etc., they should be made comparable for instance in operating profile (starts, operating hours, equivalent hours), duration (number of overhauls, Major Inspection versus smaller inspections, etc). To this respect a spreadsheet analysis program was made by NRG & KEMA covering operating profile, risk on spare parts necessary due to crashes during reconditioning (using queuing theory), scrap rate, costs of spares and total overhaul costs. The analysis program shows the dominant factors covering the

maintenance costs per MWhr produced as well as statistical boundaries for such costs. It can be used to make LTSA proposals comparable.

The presentation can be found in the closed user group.

TOP 10: Application of the PLUS and ERAP processes into the RWE npower Maintenance and Engineering Strategy
Alan Joslin, RWE npower

The Plant Life Usage System (PLUS) and the Engineering Risk Management Process (ERAP) were introduced by RWE npower and its predecessor organisations about ten years ago, and have since been developed into processes that are integral with RWE npower's engineering strategy.

Both processes are resource intensive. For example, undertaking a PLUS assessment of a typical large coal-fired power station and reporting the results could involve about 40 man-days of work. Therefore, although the output from PLUS and ERAP is recognised as being of high value, until recently they have been conducted at frequencies of only every four years on each power station, broadly to fit in with the four-yearly major overhaul programme.

This presentation includes some outline requirements for basic maintenance strategies, and goes on to discuss how the PLUS and ERAP engineering tools have been developed to enable undertaking annual reviews, and two-yearly interim studies. These require much less specialist and station resource to undertake, yet provide the majority of the value to the broad engineering strategy of the station that comes from the four-yearly full studies.

Utilising these developments, RWE npower have now introduced the annual PLUS and ERAP reviews at all its major power stations. The presentation includes examples of the outputs from the interim and annual studies.
The presentation can be found in the closed user group.

TOP 11: Place and date of next venue

The next meeting will be held on 11/.12. September 2008 in Swindon.

Essen, April 2008