
AGING MANAGEMENT IN BOHUNICE NUCLEAR POWER PLANT

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Abstract

An aging management program begun to be systematically implemented under provisions of the Slovak Electricity Company environment since 1996, when the Safety Analysis Report after 10 years of Unit 3 & 4 operation had been submitted to the Slovak National Regulatory Authority. By then, the effects of known degradation mechanisms, of which various equipment and components are prone to, were assessed through the use of existing particular programs; e.g. RPV's irradiation embrittlement by a standard design-built surveillance specimen program and neutron dosimetry calculations, then the low-cycle fatigue of the main primary components/pipelines hot spots applying computational analyses as well as the evaluation of an erosion-corrosion effect on wall thinning of critical secondary piping components. As the world's trends and progress still have continued further towards the use of more sophisticated software, hardware, diagnostics, analyses, procedures and computing, given methodologies have been modernized and the idea of operational loads on evaluated systems, structures and components – particularly their critical hot spots - has been several times revised. After issuing of country's nuclear authority safety guide No.II.5.X/2001 "Aging management of nuclear power plants. Requirements." in 2001, a project called "Aging management and lifetime optimization of nuclear power plants with WWER 440 units" had been introduced, in collaboration with the nuclear power plants research institute (VUJE) it has been developed within the period of 2002-2005.

Introduction

An aging management program begun to be systematically implemented in the Slovak Electricity Company environment since 1996. The effects of known degradation mechanisms, for various equipment and components, were assessed through the use of existing particular monitoring programs; e.g. surveillance specimen program for RPV's irradiation embrittlement, then the low-cycle fatigue of the main primary components computational analyses as well as the evaluation of an erosion-corrosion effect for critical secondary piping components. As the world's trends and progress still have continued further towards the use of more sophisticated software, hardware, diagnostics, analyses, procedures and computing, given methodologies have been modernized and the idea of operational loads on evaluated systems, structures and components – particularly their critical hot spots - has been several times revised.

The brief description of aging management process

The aging management is dynamic process used for the evaluation of real state of NPPs SCC by implementation of appropriate technical, research and diagnostic tools. The aim of these activities is to prepare and plan the effective operational and maintenance provisions. The scheme of aging management is on the figure 1.

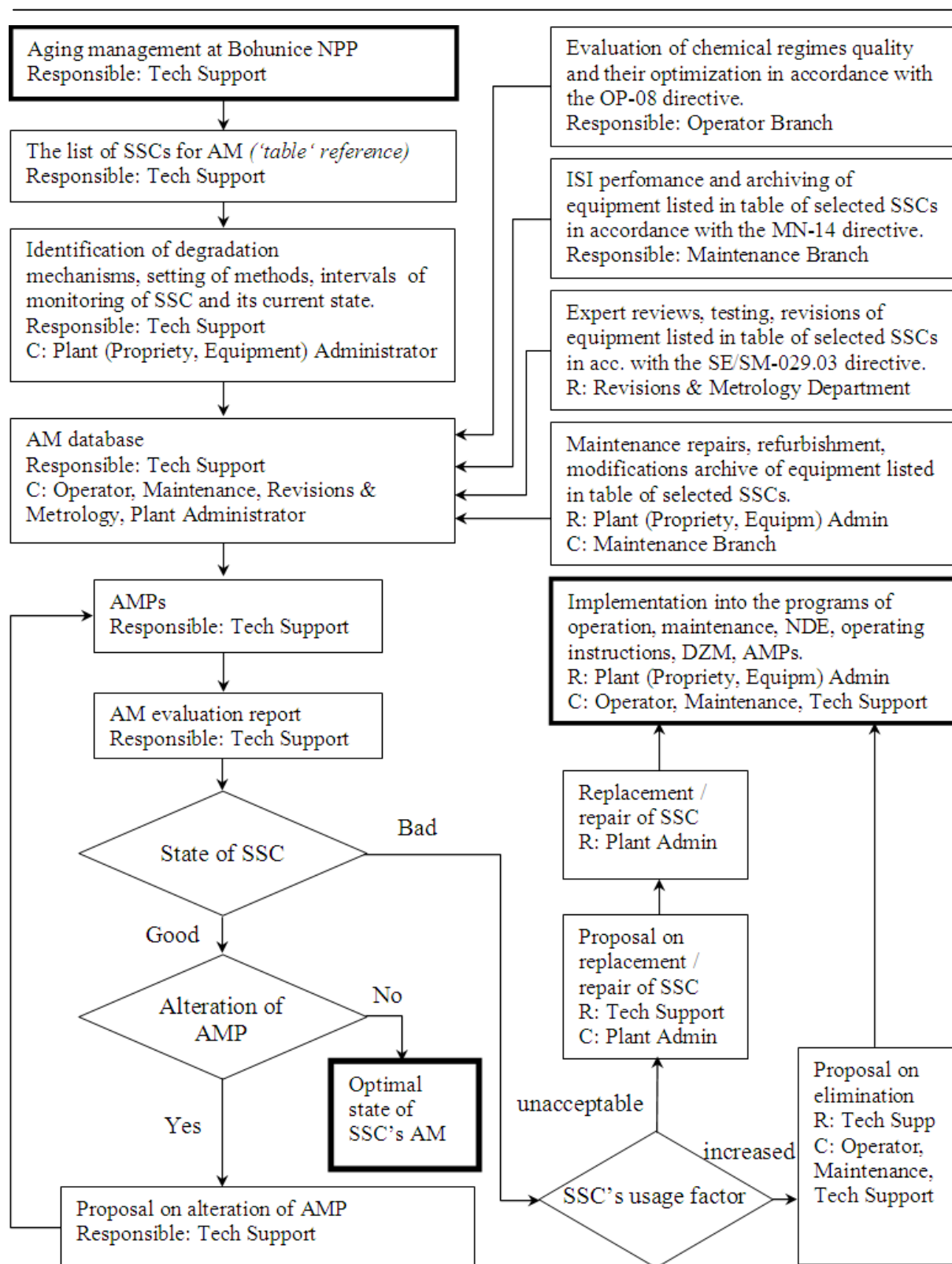


FIG. 1. Proposed steps within the aging management of critical SSC's at Bohunice nuclear power plant according to [1].

To achieve the planned aims the aging management must be organized as systematic process with following stages:

1. The understanding of SCCs aging. This is the key for effective aging management in which must be understood:
 - the material properties,
 - the operational loads of SCCs,
 - the degradation mechanisms,
 - the hot spots of degradation ,
 - the indicators of real state,
 - the issues of degradation processes.
2. The coordination of SCCs aging program - this is mainly the planning of all activities:
 - the documentation of regulatory requirements and safety criteria,
 - the documentation of appropriate activities,
 - optimization of aging management program on the base of actual informations and evaluation.
3. The operation of SCCs - the main goal of this stage is suppression of expected degradation processes with activities:
 - the operation by the operational limits and conditions,
 - the chemical regimes management,
 - the operational environment regulation,
 - the operational history monitoring including the transition processes.
4. The monitoring, diagnostic and SCCs evaluation. The corrective measures for non-acceptable degradation is the goal of the activities into this stage including:
 - operational controls,
 - surveillance programs,
 - leakage detection,
 - testing and calibration,
 - operational function evaluation,
 - the data acquisition and documentation.
5. The SCCs maintenance. Activities in this stage have the goal to improve the aging management programs effectivity as:
 - proactive maintenance,
 - corrective maintenance,
 - preventive maintenance,
 - spare parts delivery,
 - the modifications and changes of SCCs,
 - the maintenance history.

Research and development support for the aging management

For this purpose was prepared special project named “Aging management and lifetime optimization of nuclear power plants with WWER 440 units” running during the years 2002 till 2005. This complex project was prepared with close cooperation of all institutes involved in it with respect of IAEA recommendations [2] and regulatory authority too. The main goals of this project were following:

- Identify the ageing mechanisms of the safety related components.
- Development of the database for the rest of lifetime evaluation.

- Extension of the operated monitoring systems for important degradation mechanisms.
- Development of the ageing management program for minimizing the degradation of the safety related components.
- Development of the software tools, which have implemented the ageing processes.
- Development of the software for the technical and economical evaluation of the NPP components repair and replacement from the lifetime prolongation point of view.

Project's particular tasks were dealing with:

- the research and analysis of aging mechanisms,
 - the aging management programs,
 - the research on advanced monitoring systems of degradation processes,
 - the legislation base for AMP's,
 - the AM database,
 - the evaluation of the plant's long-term operation conditions efficiency,
 - legislative conditions for an approval on the NPP operation beyond design lifetime.
- The project itself has set a basis for an implementation of an aging management system under provisions of the Slovak Electricity Company environment to resolve the following issues:
- defining an effective aging management system,
 - listing of critical SSC's including their known degradation mechanisms,
 - fundamentals of SSC's and aging management programs establishment.
- The aging management programs evaluation is regularly performed per annum and within 10 years period. More detail informations are involved in special publication [3].

Conclusions

According to the actual results of the aging management programs evaluation is possible to conclude, that this system will meet the requirements of:

- Slovak Regulatory Authority (UJD SR),
- recommendations of IAEA,
- internationally approved standards used for evaluation of thermal ageing,
- the possibility to compare the results between the operated individual units not in Slovak Republic only, but with the other nuclear technologies in the world too.

REFERENCES

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- [3] Kupča, Ľ. et. al.: The monitoring programs of the safety related components NPP's WWER -440, In: The Safety of Nuclear Energy, 2007,15 (53),3/4