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NUCLEAR POWER PLANT DIAGNOSTICS-SAFETY ASPECTS
AND LICENSING**

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**SAFETY AND LICENSING ASPECTS ON NUCLEAR
POWER PLANT DIAGNOSTICS IN SLOVENIA**

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ABSTRACT.

Nuclear Power Plant incidents or accidents are initiated very often by a component failure even if it is not regarded as a safety related component. Plant safety, reliability and cost effectiveness can be enhanced and what is most important, the hazards for the environment can be reduced significantly through appropriate use of some specific Early Failure Detection Method or System.

In the present paper the current trends in Nuclear Power Plant Krško and licensing aspects introducing monitoring and diagnosis systems are described, to improve NPP reliability and safety.

Most of the nuclear power plants are currently under preparation of the program - a systematic approach to implement different Early Failure Detection Systems.

Possible contents of these programs is described in detail in several technical papers. Usually, monitoring of specific nuclear power plants parameters, components and systems shall be considered as a tool of integrity.

Reasons for monitoring are contained in regulatory requirements and in operation experience, on the other hand, the licensee is highly interested for safe and reliable operation.

The operational events and failures are usually the first initiator for systematic approach to specific phenomena observation and its analysis.

The Slovenian Nuclear Safety Administration follows the efforts of NPP Krško in all above mentioned fields including training of personnel, adequate procedures, related QA Program and experience from other NPP utilities and Regulatory Bodies.

The licensing aspects contain all the specific steps as they are required for specific plane modification. As a guide, the methodology and guidelines from the US code 10CFR 50.59 for safety evaluation are taken into account. The safety review process is a complex activity of all departments at the Slovenian Nuclear Safety Administration. In the case of an unreviewed safety question an engineering evaluation and a through understanding of the design basis of the system are essential.

In the conclusion the possibility of the early failure detection operator support systems introduction into NPP Krško regarding existing systems is discussed.

1. INTRODUCTION.

The need for diagnostics systems introduction:

- Nuclear power plant decision (different events)
- Worldwide practice and experience
- Regulatory authority requirements
- NPP designer proposal

The introduction and permanent using some or more of the diagnostics systems, the NPP operator is pursuing mainly two of the following objectives:

- assure the highest degree of safety by continually observation of the important parameters obtained by these systems,
- the cost effectiveness of the NPP will significantly increase

On the one hand, the monitoring systems working during the plant operation make it possible to assess the overall conditions of the plant at any given moment and on the another hand, the time independent evaluation and analysis will be possible.

It is very important to choose the proper technical concept for monitoring system construction and design, that will ensure the highest degree of reliability and will correspond to all licensee requests on:

- component integrity
- damage mechanisms
- specific components
- chosen measurements locations
- type of measurements chain
- method of data verification and evaluation
- regulatory position

2. PRESENT STATUS IN NPP KRŠKO.

On the recent operating experience, in NPP Krško currently the following diagnostics activities are in use:

- motor operated valves diagnostics measurements
- thermography on electrical and mechanical components
- vibration monitoring of specific rotating equipment

All above mentioned diagnostics methods are used in the case of their need, there is no permanent system on line placed on some system or component.

Some of the monitoring systems were the part of the original power plant design (vibration monitoring of the main turbine-generator set, for example) and currently there is no specific need to introduce some new ones.

In the last few years, as a type of operator computerized support system was introduced, called Process Information System. It is a type of data acquisition system with few hundred of process variables on the computerized system, which allows operators or other plant personnel to follow on line chosen variables.

3. LICENSING ASPECTS OF NPP DIAGNOSTICS.

The licensing of new diagnostic system is a process which shall contain all the activities requested by regulatory authority (legislation) requests and also the requests from international codes and standards.

The following parts of licensing process are the most important:

- the impact on safety in different operational modes
- qualification of the systems with appropriate methods and procedures
- acceptance criteria for methods used in the process of qualification
- determination of the threshold values for different actions
- regulatory authority reporting requests
- affects on technical specifications, procedures, safety analysis reports and other documents

The Slovenian Nuclear Safety Administration follows the worldwide practice and experience. Introduction of the new diagnostic system will be the case of safety important modification in the situation, that the diagnostic system will be in the coincidence with some safety related function of specific safety feature.

The methodology and guidelines from the US code 10CFR 50.59 are followed in the process of safety evaluation. In the case of an unreviewed safety question an additional engineering evaluation of the diagnostic system design basis will be necessary.

Important consideration is that a change to non-safety related equipment not described in Final Safety Analysis Report can indirectly affect the capability of equipment important to safety.

Regulatory authority communicate with the licensee through asking relevant questions based on the engineering and safety evaluation of the diagnostics system to be installed at the NPP.

Examples:

- change convert of feature that was automatic to manual or vice versa
- introducing an unwanted or previously unreviewed system interaction
- change affect the seismic or environmental qualification of the system
- new electrical loads introduced
- maintenance, testing, personnel qualification

4. SELECTION OF THE SYSTEMS (COMPONENTS) TO BE MONITORED

The decision of the nuclear power plant intention to introduce new diagnostics monitoring system is usually based on the indicators from:

- transients, damage, failures
- operational history of the components important to safety
- boundary conditions obtained from stress and fatigue analysis
- experience from inspection
- life extension (ageing phenomena)

The monitoring system is basically global or local and each shall be continuous or not continuous.

It is important to properly locate the measuring points, choose the data type to be monitored and which measurement system will be in use, on the other hand, the decision should be made on damage mechanism that will be observed in which operation modes.

5. CONCLUSIONS

The decision for introduction of the specific monitoring system into nuclear power plant is a complex task. First of all, all the operational events and power plant performance indicators should be the basis for such decision. Using the

international experience and databases is necessary. The computerized diagnostics monitoring systems should be considered as a helpful operators support tool.

Such systems aid them to diagnose the abnormal behavior of certain parameter before the normal alarm limits are reached. The monitoring and diagnostics function is to alert the operators to the safety status of the plant.

Applications of the monitoring and diagnostics systems are already in operation or under development in many countries. They are sometimes integrated with other operator support system .

Slovenian Nuclear Safety Administration strongly supports all activities for achieving higher level of nuclear safety through introducing diagnostics systems.