OSART Good Practices

TECHNICAL SUPPORT

Surveillance programme

Ignalina, Lithuania

Mission Date; 5-21 Jun., 2006

Implementation of leak detection system

A unique for the RBMK reactor concept of leak detection system (before break) is being implemented at the plant. It allows lowering the sensitivity threshold significantly and as a result improving detection of coolant leaks on pipes and equipment located at the boundary of leak tight compartments. A system for monitoring of the pipelines in under reactor compartment and sections of steam pipelines has already been put into operation.

The test results of the installed systems confirmed that they ensure leak detection within one hour and inform about leak tightness failure at coolant pipelines and equipment by the rate of leak 10 times less than the critical one. This system also informs the location of the leak.

For the steam line leak detection, isolation humidity control according to the radar principle is applied. If there is ingress of moisture to the detector, its electrical resistance of fiber cable changes and can detect leak and identify the place. For another places like below reactor, humidity measuring and aerosol activity measuring is used. All these data are automatically analyzed and shown on the computer screen including main control room in a user- friendly manner.

Mochovce, Slovakia

Mission Date; 4-20 Sep., 2006

Cooperative work of field and engineering activities results in successful utilization of computer based systems applied for various uses of technical evaluation and analysis.

- Surveillance test
  Data issued from surveillance programmes are collected in databases. Databases enable the plant to collect data, analyze, archive, create trends and prepare to interpret the analyzed data. Computerized data are easily acquired from the database. Owing to this database, the tests are performed on the schedule, and technicians can know the necessary workforce in advance.

- Plant modification system
  Status of prepared modification is controlled by a computer system. The system relevant to modification schedule deal with priority, schedule and so on. The system enables the plant to list the modification plans and perform co-ordination between different kind of plans. The system archives data on deadline for each modification plan, so that relations between modification plans are easily organized. Data are available on the network for all departments involved in plant modification system.

- Aging Management
  Specialized database enables the plant to collect and analyze data from the plant related to aging management. The analysis not only enables the plant to predict ruptures early, it enhances communication between technical staff and administrative staff by showing the aging curve. The analysis provides users with a good view of equipment and tables of archived data.

- PSA
  PSA analysis is referred to for decision making of modification, to determine the impact from the given modification.

Khmelnitzky, Ukraine

Mission Date; 29 Oct.-14 Nov., 2007

A programme on long term support of reliability of electrical cables

KhNPP is the pilot plant for Ukraine that commenced a comprehensive long term support of reliability programme related to the assessment of selected electrical cables.

The programme aims to evaluate the long term support of reliability of electrical cables under given operational and environmental conditions and provide basis for re-assessment of cable qualified life. The programme involves the following activities:

- Evaluation methodology elaborated for cable assessment; it involves identification of
- representative cable type, environmental parameters monitoring (temperature, humidity,
- ionizing radiation, etc.), analysis of operating conditions, maintenance records, etc;
- Monitoring of real environmental conditions in which cables are installed;
- Installation of cable specimens in a special depot in the containment so that to simulate
- accelerated thermal and radiation ageing;
- A systematic analysis of collected information so that to determine the level of
- degradation for each cable type;
- Early implementation of preventive measures to eliminate or slowdown the ageing effects
- in long term; and
- Justification of remaining service life of electrical cables.

Balakovo 4, Russia

Mission Date; 19 May-5 Jun., 2008

The methodology "Defining of steam-air medium leak from containment via measurement of pressure difference and flow" used for measuring the containment tightness.

Balakovo NPP put into operation the system of containment tightness measurement using the methodology "Defining of steam-air medium leak from containment through measuring of pressure drop and flow", developed by JSC IN-PK "Russian Energy Technologies".

The methodology comprises 3 methods of "leak measurement":

- method of leak measurement by pressure drop, in %/ day (MLMPD);
- method of leak measurement by flow, in cm3/h (MLMF);
- method of leak measurement based on pressure drop compensation, in m3/hour (MLMPDC).

The 3 methods of "leak measurement" are detailed below:

- MLMPD method is based on measurement of pressure drop between the control tank, which is the part of VIU-D device, and the containment. For the testing period three VIU-D devices are installed in the containment to measure pressure drop. The concept of this method is as follows:
- Due to medium leak, the pressure in the containment reduces. At the beginning of measurement pressure in the containment and control tank is kept in balance with the help of the measuring valve. After the valve closure the air mass in the control tank remains permanent. After the fixed time period the leak measurement instrument will show difference between absolute pressure in the control tank and containment.
- The method of leak measurement by flow is based on measuring the air mass flow after opening of the measuring valve. The MLMPD and MLMF are performed simultaneously.
- The MLMPDC method is based on balancing of the air mass escaping from the containment because of the leak and the air mass pumped from the outside. Balance of the pumped and the leaking air is tracked on the base of flow and change of differential pressure between the control tank and the containment. In case the flow and the differential pressure change are equal to zero, the medium leak from the containment and medium pumping are considered to be the same.

The leak is calculated based on the data obtained.

Advantages of the new "Methodology"

- Total testing time according this"Methodology" is 22 hours, including time for
- depressurization, pressure rise, stabilization, measuring and pressure drop within the
- containment (before implementation of the new method the testing took up 2 days);
- It is performed by three independent methods and so it is more reliable;
- In future this method can be applied with Unit on power;
- Human factor impact on testing results is excluded.

Vandellos 2, Spain

Mission Date; 21 Sep.-8 Oct., 2009

The plant has developed an Access database that links each of the plant licensing bases to the relevant plant system and to all the relevant supporting documentation.

This database is used in several ways to support the plant in licensing and in the development of design modifications packages. For instance:

- It allows the licensing department to check what supporting documentation could be affected by regulatory changes that can affect the licensing bases and also to check which systems could potentially be affected.
- It allows the design engineering team to identify the licensing bases that should be considered in the development of design packages and also to identify which supporting documentation may need to be updated.

Temelin, Czech

Mission Date; 5-22 Nov., 2012

Measurements of flanges on the reactor vessel head of VVER 1000 Reactors using the MARPOSS System

Description:
The Marposs system is used to measure internal and external diameters on the flanges of the reactor vessel head:

- Flanges for control rod drive mechanisms;
- Flanges for in-core instruments;
- Flanges for the reactor vessel vent lines.
-

The dimension of the flanges is important for making the connection to connecting parts seal tight. The new measuring device is a two-point gauge that measures the ovality of the flanges with an accuracy of 0.001mm. The design of the gauge ensures that the measurement is always performed in the same position of the flanges. This ensures the repeatability and independence of human errors. The gauge is checked against calibrated samples, specific for each measured flange. Evaluation is performed by using the evaluation unit Merlin or Merlin Mobile. The result of the measurement can be numerical or, when the detected values are stored in the memory of the evaluation unit, by colour indication. The colour indication provides a fast and unambiguous reading whether or not the measured value is within the required tolerance.

Benefits:
Communication between the M1WAWE sensor and the MERLIN or MERLIN MOBILE evaluation unit is wireless, via Bluetooth. Since it is a two-point gauge, it is possible to determine ovality easily by turning the gauge according to the coordinates on the flanges. Operator's performance cannot affect the measurement result. This is a guarantee for consistent results and a possibility for trending data. The previously used method was performed by using conventional three-point inside callipers from different manufacturers. This method had the disadvantage that human factors could have a significant impact on the measurement result. This made it difficult to ensure measurement repeatability.

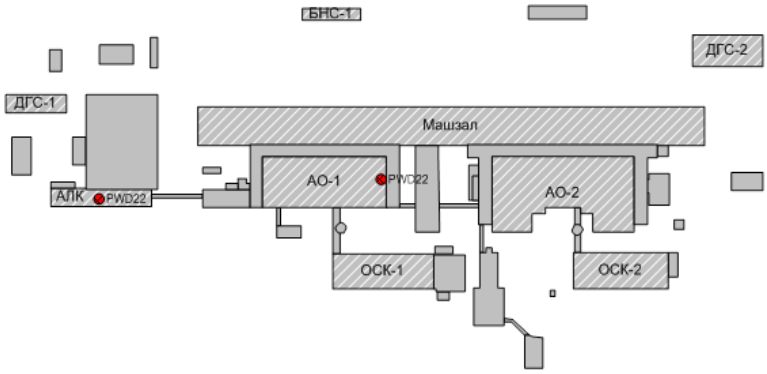
Results:
The gauge has been used with good result to measure the ovality of lower flanges on the reactor vessel head. The gauge was also tested with good results during an inspection of dismounted upper flanges. In addition to good measurement accuracy and safe storage of data the use also reduced the measurement time to a quarter of time spent using the previous method. As a result of this, the staff performing the measurements received a lower collective dose. Due to the wireless communication and automated recording of measurement results has errors due to oral transmission been eliminated.

Kola, Russia

Mission Date; 10-27 Nov., 2014

Snow load monitoring system to avoid critical snow loads on roofs.
In the case of extreme weather conditions in combination with continuous and abundant snowfall and extreme wind, the plant may have difficulties with timely cleaning the snow from plant roof surfaces.

Kola NPP has developed and implemented a system of snow load monitoring with sensors of actual weather in the following locations:



The software has been launched to provide for control of roof coating from the responsible personnel's working places (shift engineer, control room) and forecasting of possible loads in the case of abundant snowfalls.

The main task of this monitoring system is to give a timely signal to the plant personnel that it is necessary to clean snow from the roof surfaces in a case of extremely unfavourable weather conditions with the following benefits:

- Prevention of excessive snow loads on roof surfaces of buildings housing safety related equipment.
- Does not require major financial investment.
- Reliable work (using equipment with high reliability plus back-up).
- The equipment does not affect the removal work as it need not be installed on the roof.
- Provides online forecasting to arrange for timely cleaning.
- Simple interface that does not require special training.

Bushehr, Iran

Mission Date; 29 Sep. -17 Oct., 2018

Establishment of the in-house Research and Development Team and the Assessment Approval Committee for non-destructive and destructive examinations, failure analyses, as well as design and manufacturing of robots to be used in surveillance and recovery activities.

Benefits: The following activities by the Research and Development Team are considered supporting the plant's operational safety:

- Quick and primary study of potential causes of various defects and failures for any equipment.
- Provision of scientific conclusion and technical reports on the root causes of failures and sharing the identified issues and findings with other institutions and universities for further studying and potential research.
- Establishment of a common platform and language between universities, institutes and non-nuclear industries.
- Studies of operational experience of other nuclear power plants and starting projects with cooperation from academia and institutions to explore appropriate measure against the possibility of similar events.
- Conceptualize, propose, design and cooperate with the companies that manufacture inspection equipment which are suitable for use in BNPP conditions. For example, a robotic vehicle was manufactured for the inspection of spent fuel pool and reactor vessel and another for the search and recovery of parts that fell into the primary circuit.

Tricastin, France

Mission Date; 28 Nov. -15 Dec., 2022

The plant has developed unique monitoring tools to facilitate routine engineering scrutiny and early detection of plant performance degradation (VIFE-VIGIE-NOVA)

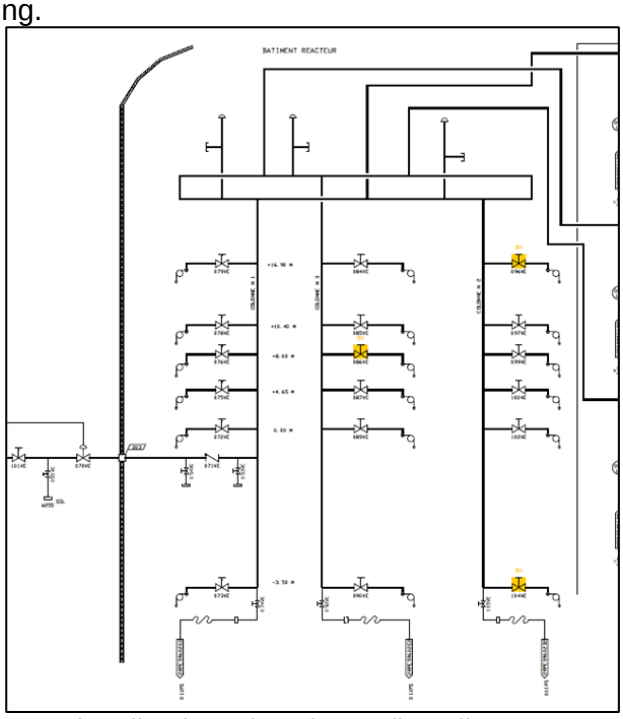
Purpose

The goal of this tool is to facilitate the early identification of equipment adverse trends, using all available online measurements, work orders, giving an aggregated ‘bird eye’ vision of safety related systems. The ultimate goal is improving the availability and reliability of plant safety systems.

Description

The plant has developed a unique integrated IT system that collates inputs from different monitoring tools to facilitate the early detection of adverse trends. This tool is used every day during the morning engineering meeting, to assess the threats on safety related SSCs and functions. It includes the following components:

- An automatic generation of pre-alarms for each system, that enables easy visualization of situations that could degrade the reliability of SSCs, before it could ultimately lead to actual alarms in the MCR or to equipment unavailability. Pre-alarms are based on sensors or calculated combination of sensors. Additional measurements are added when needed. The system provides the history of pre-alarms, accurate monitoring of sensors, and recording the results of the assessment performed by the engineering department.
- An automatic detection of slow adverse trends.
- An automatic visualization of preventive and corrective works directly on flow diagrams, which allow for easy detection of higher threats on specific systems or trains and for example, can trigger a re-prioritization of maintenance activities.
- Synoptic screens present in real time, a ‘bird’s eye’ vision of systems or functions. Synoptics facilitate the overall assessment of safety systems reliability during the morning engineering meeting.



Visualization of works on flow diagrams

The interface of this tool is easy to use.

Benefits

This system allows easy detection of adverse trends and issues in safety related systems. Actual

early detections of issues are recorded as ‘Victories’ and put in an honor panel in the morning meeting room. Example of recent victories:

- Identification of a pressurizer level measurement that was about to fail. The sensor was replaced before its failure thanks to the engineering feedback.
- A main steam flow sensor that slowly started to drift and could be handled before it led to an actual problem.
- The detection of a wrong line-up on the reactor building ventilation system during outage, was identified based on early detection of the temperature evolution.

This tool contributed to the significant improvement of safety systems reliability over the last few years.

HEYSHAM 2, United Kingdom

Mission Date; 2 - 19 Oct., 2023

Electronic Laptop Lockers and Key Storage

The plant Electronic Key Management System has been deployed for plant access laptops, keys, and USB removable media across the site to ensure mitigations are in place for all plant programmable equipment. The system ensures that only authorized people have access to areas and equipment important to safety, for example, when hardware or software of plant computer systems is modified. The lockers are also used in the central control room where the Electronic Key Management System contains electronic tablets. During events that could result in loss of control room instrumentation, operators can access the tablet and connect them to installed connections points from which they can monitor key plant parameters.

The Electronic Key Management System lockers use fingerprint technology to authenticate users to retrieve their key, media or laptop. The system can be configured with built in charging and a Radio-Frequency Identification device tracking if required.

Figure 5.1: Laptop lockers using Electronic Key Management System