framatome

LPMS / VMS

Combined Loose Parts and Vibration Monitoring System

Fully automated loose parts monitoring and component vibration assessment allows operators to anticipate, detect and prevent failures on major components

Challenge

Loose parts in the reactor coolant system (RCS) of nuclear power plants (NPPs) pose a significant threat to the operational safety of components inside this system. Even small loose parts are able to damage fuel assemblies and other components. The prompt and reliable detection of loose or loosened parts in the RCS prevents consecutive damages of the fuel assemblies, pump blades, cladding or the steam generator's U-tubes.

A change in the vibration behavior of a component is one of the most sensitive indicators for changes in its mechanical condition. Therefore, it is essential to monitor and assess the component vibrations during plant operation to validate the mechanical integrity and to ensure a reliable plant operation with high availability.

Solution

The lean and economic combined loose parts and vibration monitoring system supports the operator to better anticipate, detect and prevent failures on major components of a NPP.

The loose parts monitoring part of the system (LMPS) identifies loose or loosened parts in real-time. It automatically monitors and records structure-borne noises, detects signal bursts, analyzes and locates them and finally assigns them to event classes. Based on the event classes the system provides information on the properties of the bursts as well as diagnostic information to the plant's operator. A highly sophisticated event classification and pattern recognition function decides whether the given event belongs to a group of known events which do or do not require alarm or is an unknown event type. The loose parts alarm to the control room is only activated if necessary.

The scope of the vibration monitoring part of the system (VMS) varies depending on the reactor design and applicable standard. The main objective is an early detection of beginning damages to initiate suitable corrective measures in good time and, thus, the prevention of consequential damages and unplanned down-time. The system may rely only on existing neutron flux noise sensor data or use a variety of specialized sensors specific for the system, for example, absolute displacement sensors on the reactor pressure vessel (RPV) closure head.

Your performance is **our** everyday **commitment**
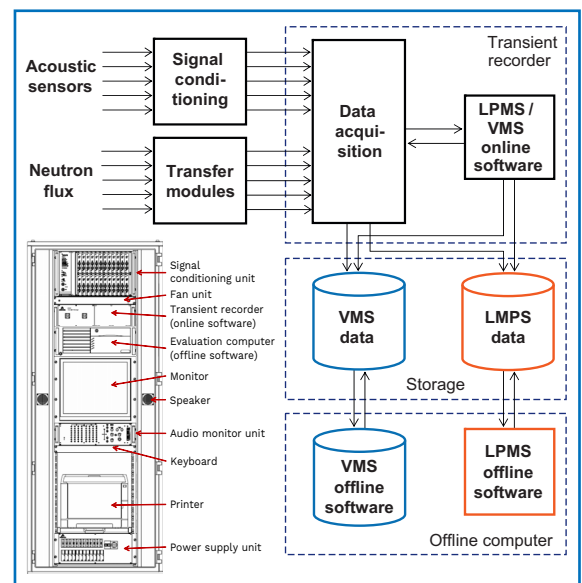
System architecture of the combined loose parts and vibration monitoring system; one cabinet is sufficient for standard functionality

Customer benefits

The combined loose parts and vibration monitoring system:

- Protects assets by real-time analysis of loose or loosened parts
- Contributes to safe and cost-effective plant operation
- Detects mechanical irregularities and incipient damages early
- Increases plant availability by minimizing false or unnecessary alarms and usage of advanced data evaluation methods
- Prevents unnecessary maintenance by supporting condition-based maintenance
- Allows automatic generation and trending of parameters derived from vibration data
- Allows post-fault analyses – if something happens, it's recorded.

Technical information

Loose parts monitoring

- Compliance with NRC 1.133, IEC 60988 and DIN 25475 Part 1
- Event triggering with relative and absolute thresholds
- Event classification and pattern recognition
- Alarm inhibit from the main control room depending on the classification (for example, in the case of known acoustic events like control rod movements)
- Adaptive, teach-in system, graphical event analysis, digital signal processing functions
- Analysis in the time and frequency domain
- Event localization with different methods
- Mass estimation
- Statistical evaluation functions

Vibration monitoring

- Compliance with IEC 61502 and DIN 25475 Part 2
- Special sensors for vibration monitoring like absolute and relative displacement, pressure fluctuation or accelerometers available
- Monitoring of the reactor coolant pumps can optionally be covered within the same system

General

- Remote-controlled calibration functions (only with Framatome preamplifier / charge converters or displacement sensors)
- Automatic in-service inspection functions
- Automatic and cyclical protocols
- Long-term storage function
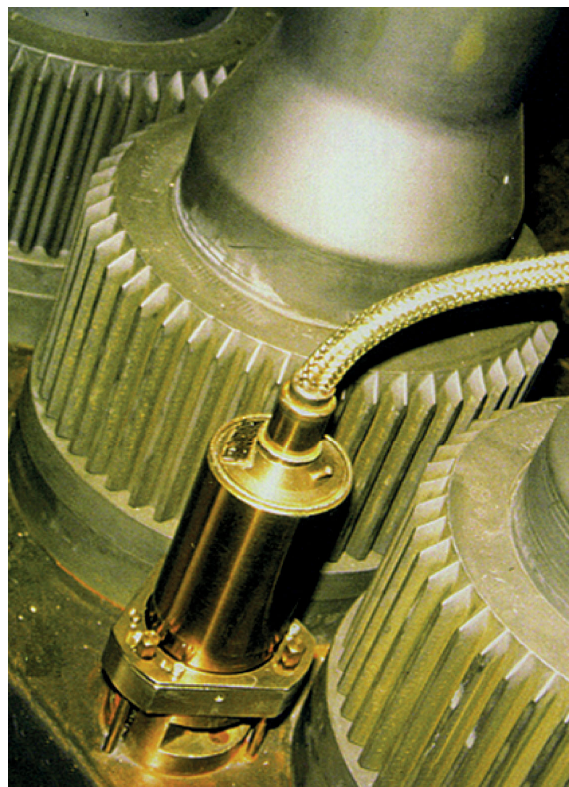
Special high-sensitive absolute displacement sensor for application in harsh environments (like measuring RPV vibrations at closure head)

Key figures

More than **50** systems in operation

Over **30** years of operational experience

In operation in **5** different reactor types

References

North America
- USA (PWR)

South America
- Brazil (PWR)
- Argentina (PHWR)

Loose Parts Monitoring System
Vibration Monitoring System

Western Europe
- Finland (EPR reactor)
- Belgium (PWR)
- Netherlands (PWR)
- Spain (PWR)
- Switzerland (PWR)
- Germany (PWR and BWR)

Eastern Europe and Russia
- Russia (VVER)
- Slovakia (VVER)
- Czech Republic (VVER)

Asia
- China (EPR reactor)

PWR: pressurized water reactor   BWR: boiling water reactor   PHWR: pressurized heavy water reactor   VVER: water-water power reactor

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