

FLUS

High-Sensitivity Leak Detection and Localization and Humidity Measurement System

High-sensitivity and accuracy leak detection and localization protects assets and personnel, avoids significant follow-up costs and ensures plant reliability without any undetected leaks in 170 collective years of experience.

Challenge

Leaks within the containment of nuclear power plants (NPPs), e.g. at the hot leg or the pressurizer surge line, need to be detected at the earliest moment in order to avoid high losses of coolant or even more severe plant damages. The earlier a leak can be detected, the lower the costs are for operators to repair the damage and to guarantee safe plant operation. It is generally difficult to detect leaks early and locate them exactly under the insulation on pressurized pipes and vessels in NPPs.

For application of the leak-before-break (LBB) concept, it needs to be demonstrated that a postulated small “through wall” crack will be reliably detected by the plant’s leak detection system.

Solution

The high-sensitivity leak detection and localization and humidity measurement system, FLUS, detects and localizes even the smallest leaks at an early stage in pressurized insulated pipes and vessels in NPPs.

Leakage in a pipe or component always leads to both a significant increase in the local humidity around the leak and – if a certain leak rate is reached – also to an increase in the global humidity inside the equipment compartment. The continuous measurement of the local humidity at the monitored components enables detection of external leaks from cracks, of flange connections, valves, isolating valves, etc. after one hour at the latest and evaluation of the leak-rate development – even throughout the entire power range from 0 to 100%.

Compact metallic “humidity sensing elements” or linear “sensor tube” sections are installed wherever humidity is to be measured as an indicator for potential leaks. These elements take air samples for humidity analysis in one central monitoring station.

FLUS fulfills the requirements of high-sensitivity crack-related leak detection required for safety reasons with respect to LBB or the break-preclusion concept (BPC).



FLUS humidity sensing elements

Customer benefits

FLUS:

- Protects assets and personnel, and avoids significant follow-up costs through high-sensitivity leakage detection
- Ensures plant reliability
- Uses robust passive metallic components (no electronics) in non-accessible areas with high temperatures and radiation, which results in minimal maintenance and repair costs
- Fulfills LBB and BPC requirements
- Reduces risk of potential contamination, and supports ALARA principles.

Your performance
is **our** everyday **commitment**

Technical information

Main system features

- Extremely high detection sensitivity (1 kg/h; 10 kg/h for components and compartments)
- Short response times (typically 20 to 60 min)
- Leakage pinpointing typically within 1 to 2 m on components
- Quantitative room-humidity measurements, typically 1 to 50 g/kg
- Automatic integral self-test and simple on-site performance verification
- Multi-channel analog output of measured values
- Only passive metallic components (no electronics) in non-accessible areas with high temperatures and radiation
- Flexible expansion to up to 6 monitoring lines per system
- Performance that surpasses the requirements of the international standards for leakage monitoring (IEC 1250, NRC 1.45, KTA, YVL, etc.)
- Classification as F2/safety-related system (depending on national regulations)

Other application examples

- Leakage monitoring of the reactor pressure vessel (RPV) head
- Installation of FLUS sensors on pressurizer and surge line
- Monitoring of the bottom head of a RPV
- Room-humidity measurement in the reactor building



Leakage monitoring on the main steam pipe using humidity-sensing elements

Key figures

More than **170** collective years of experience

0 leakages undetected by FLUS
(including on-site leak-simulation tests)

Application in **5** different reactor designs

18 systems in operation of which **10** are in non-OEM plants

OEM: original equipment manufacturer

References

North America

- Canada (CANDU reactor)
- USA (PWR)

Western Europe

- Finland (EPR reactor)
- Sweden (BWR)
- France (PWR)
- Germany (PWR)

Eastern Europe and Russia

- Russia (VVER-1000)
- Slovakia (VVER-440)
- Bulgaria (VVER-1000)

Asia

- China (EPR reactor)

PWR: pressurized water reactor

BWR: boiling water reactor

VVER: water-water power reactor

CANDU: CANada Deuterium Uranium

Contact: monitoring-and-diagnostics@framatome.com
www.framatome.com

It is prohibited to reproduce the present publication in its entirety or partially in whatever form without prior written consent. Legal action may be taken against any infringer and/or any person breaching the aforementioned prohibitions.

Subject to change without notice, errors excepted. Illustrations may differ from the original. The statements and information contained in this publication are for advertising purposes only and do not constitute an offer of contract. They shall neither be construed as a guarantee of quality or durability, nor as warranties of merchantability or fitness for a particular purpose. All statements, even those pertaining to future events, are based on information available to us at the date of publication. Only the terms of individual contracts shall be authoritative for type, scope and characteristics of our products and services.

framatome****