# **framatome**

## **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.



FLUS humidity sensing elements

#### **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).

## **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**

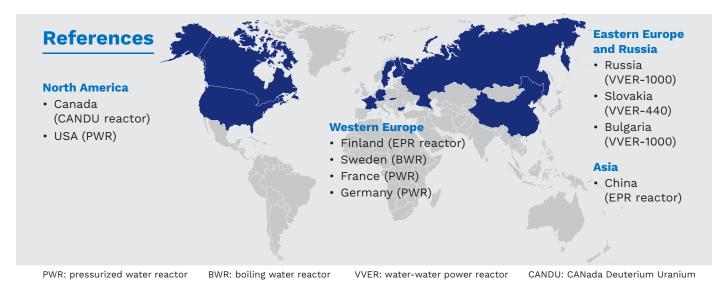
More than 170 collective years of experience

• 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



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