framatome

HERMETIS

Multi-Functional Containment Atmosphere Monitoring System

HERMETIS provides precise information about combustible gas concentrations by automatic extraction of super-heated micro samples from the containment during a severe accident (SA).

Challenge

High energy content of hydrogen containing gas mixtures during SAs may jeopardize the integrity of the containment structure representing the final barrier against large unfiltered activity releases to the environment.

Adequately managing different SA scenarios is complicated by a lack of available information during degraded plant conditions. Existing instrumentation will most likely be lost or produces incorrect data in SA conditions.

Monitoring the combustible gas concentration is essential to interpret accident progressing, initiate appropriate mitigation measures and check the effectiveness of counter-measures.

Solution

HERMETIS extracts automatically micro samples in-situ from the containment atmosphere at representative positions. By superheating the sample directly after the extraction the volumetric concentration remains unchanged and allows the precise measurement of the hydrogen and the steam concentration.

The extracted micro samples are transported to outside the containment to be analyzed in a sampling module. Micro sampling and installing the sampling module under mild environmental conditions minimizes the dose and other environmental loads on the sampling module.

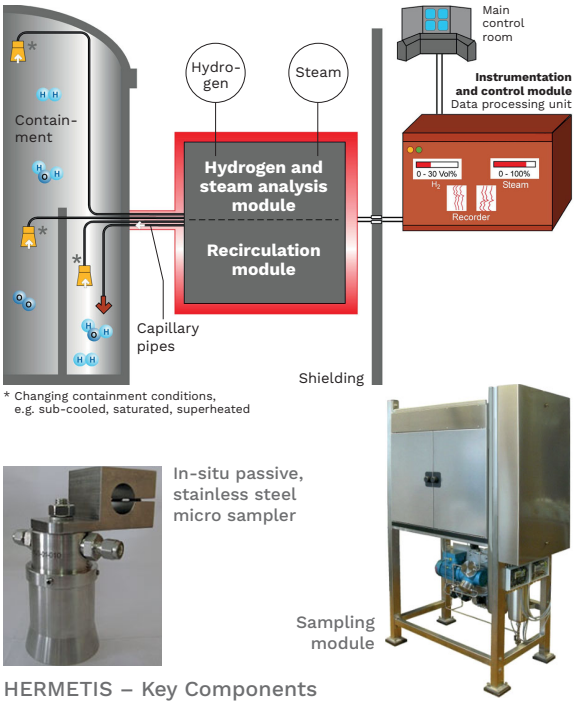
The in-situ micro-sampler installed inside the containment is a passively working equipment made from stainless steel withstanding even harshest environments during SAs.

In combination the hydrogen and steam concentration are used to evaluate the potential combustion regime prevailing inside the containment with its resulting risk for containment's integrity.

The effectiveness of already initiated counter-measures is continuously monitored and the potential implementation additional mitigation efforts can be evaluated.

Optional the HERMETIS system can be equipped with a carbon monoxide measurement which allows the detection of Molten core concrete interaction. An optional oxygen measurement completes the system's functionality with special benefits for containments with inerting conditions.

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



HERMETIS – Key Components

Customer benefits

- Only one system for design-basis accident and SA with modular design
- High accuracy for gas concentration measurements by micro sample superheating
- Reliable information about the combustion regime inside the containment for severe accident management and emergency planning
- Flexible customization (type of measurements, amount of measuring points) to the needs of the application and monitoring requirements

Technical information

Measurements

- Hydrogen: 0–30 vol.-%
- Steam: 20–70 vol.-%
- Oxygen: 0–25 vol.-%
- Carbon monoxide: > 0.1 vol.-%
- Containment pressure: 10 bar abs.

Containment conditions

- Pressure: up to 10 bar
- Temperature: 170°C (short term > 250°C)
- Activity concentrations: > 10^{15} Bq/m^3
- Accumulated adsorbed: up to 5000 kGy

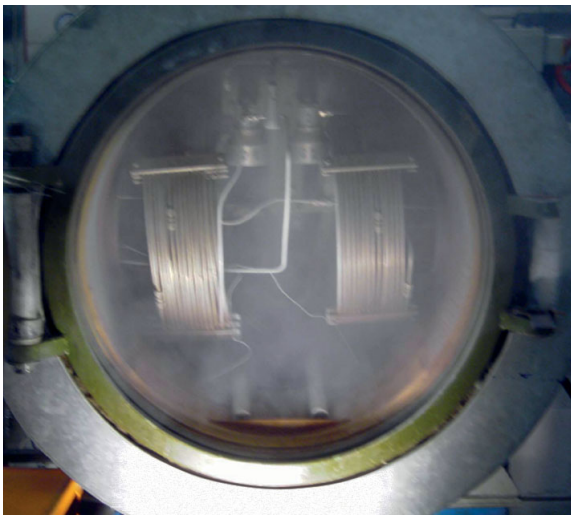
Fully qualified for SA loads such:

- Temperature, pressure
- Presence of aerosols
- Operation of spray including boric acid and other additives
- Combustion

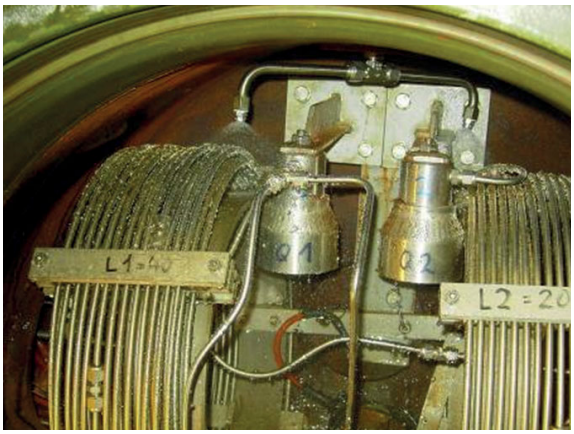
Fully qualified for external events

- Safety shutdown earthquake
- Air plane crash

Qualification according international nuclear standards (IEEE, YVL, KTA)



Aerosol test



Spray test

References

- Eastern Europe: 4 VVERs
- Western Europe: 1 EPR
- China: 2 EPR
- Japan: 1 BWR

BWR: boiling water reactor VVER: water-water power reactor

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