

Movable Incore Flux Detector

Reliable neutron flux measurement for reactor core monitoring and calibration

Designed to perform periodic neutron flux measurement inside the core under the most challenging environmental conditions with precision and reliability

Challenge

Plants must have highly responsive and reliable incore neutron flux instrumentation for safe and accurate core monitoring and calibration.

The thermal neutron flux of a reactor is a reflection of the instantaneous nuclear power. The sensitivity, accuracy and availability of the flux detection system is crucial for safe and reliable plant operation because the periodic measurement of the neutron flux directly inside the reactor core provides information on local power fluctuations. It also provides operators the radial and axial power distribution and calibration of the excore instrumentation. Both are essential for safe plant operation.

Solution

Framatome's movable flux detectors, and neutron flux instrumentation equipment and systems, are built on over 40 years of operational experience. These systems are validated to operate under normal reactor operating conditions and designed for reactors with L-shaped and U-shaped incore tubing.

The precise, neutron-sensitive fission chamber allows the incore neutron flux instrumentation system to monitor changes in local conditions inside the reactor core. The resulting signal can be used for both reactor protection and surveillance.

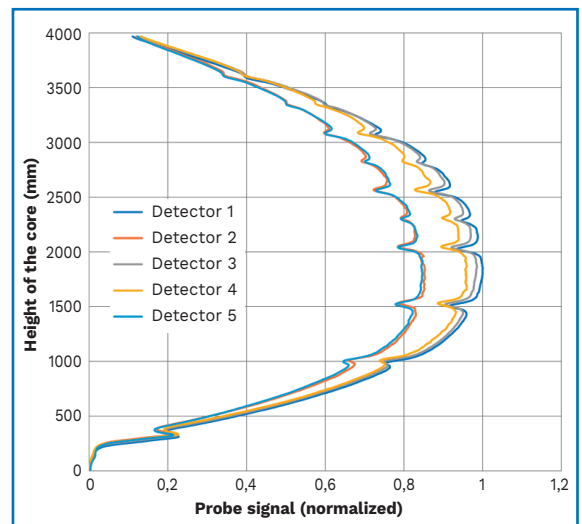
The Framatome incore neutron flux instrumentation is designed for smooth operation and maintenance while enhancing operational margins by improving reactor safety.

Services cover the complete system, including equipment and system validation to international standards, hardware, training of personnel, comprehensive testing, and maintenance.

The solution can also easily integrate into existing instrumentation and control (I&C).



Movable incore neutron flux detector probe



Axial distribution of the flux for five detectors during a pass in the core

Customer benefits

- Calibrations performed within the reactor result in increased accuracy of the measurements
- High strength of the push and pull cable drastically decreases detector sticking problems
- Long service life thanks to specific design and materials
- Full-service maintenance is available to relieve operator burden
- Maintenance activity training for plant personnel makes implementation smoother

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

Technical information

Type of incore tubing

L-shaped

U-shaped

Dimensional characteristics

Probe diameter	4.7 mm	4.7 mm	4.7 mm
Probe length	66 mm	56 mm	56 mm
Sensitive section length	27 mm	17 mm	17 mm
Propulsion cable length	30 m	54 m	45 m

Material

External casing	Stainless steel	Stainless steel	Stainless steel
Sensitive layer	Uranium (90% U ²³⁵)	Uranium (90% U ²³⁵)	Uranium (90% U ²³⁵)
Connector	FFS 01250 DLAE 31	SX 01B 0503	FFS 01250 DLAE 31

Electrical characteristics

Nominal voltage	150 V	150 V	150 V
Voltage operating range	50 - 200 V	50 - 200 V	50 - 200 V

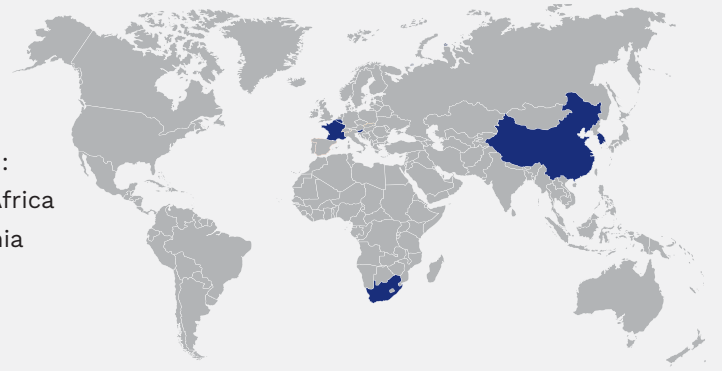
Nuclear characteristics

Thermal neutron sensitivity (A/n·cm ⁻² ·s ⁻¹)	1 10 ⁻¹⁷	0.7 10 ⁻¹⁷	0.7 10 ⁻¹⁷
Maximum gamma exposure	1.7 10 ⁷ Gy·h ⁻¹	1.7 10 ⁷ Gy·h ⁻¹	1.7 10 ⁷ Gy·h ⁻¹
Gamma sensitivity (A/Gy·h ⁻¹)	≤ 2 10 ⁻¹²	≤ 2 10 ⁻¹²	≤ 2 10 ⁻¹²
Neutron flux operating range (n·cm ⁻² ·s ⁻¹)	10 ¹⁰ to 1.4 10 ¹⁴	10 ¹⁰ to 1.4 10 ¹⁴	10 ¹⁰ to 1.4 10 ¹⁴



References

- More than 40 years of operational experience
- More than 100 reactors equipped across the world:
 - L-shaped incore tubing: China, France, South Africa
 - U-shaped incore tubing: Belgium, Korea, Slovenia



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