

Ex-core Neutron Flux Instrumentation in PWRs

Inevitable to control and protect a pressurized water reactor

Designed to perform neutron flux measurement outside of the core under the most challenging environmental conditions and to comply with internationally recognized standards.

Challenge

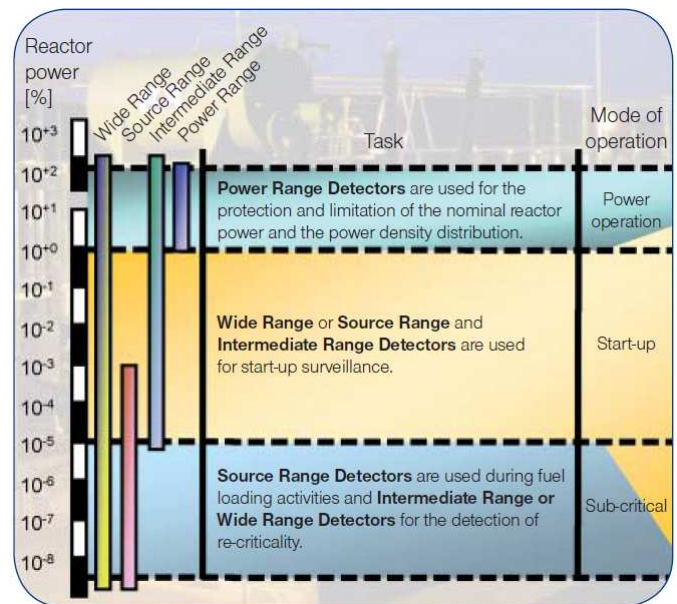
The reactor neutron flux is a measure for the instantaneous nuclear power. The continuous measurement and processing of the neutron flux provides further information on power fluctuations as well as the radial and axial power distribution of the core. A safe and reliable ex-core neutron flux instrumentation is thus inevitable to protect and control a reactor.

Solution

Based on more than 30 years of operational experience Framatome NP has the expertise to design ex-core neutron flux instrumentation which complies with customer-specific reactor types, covering the whole neutron flux measuring range from refueling, start-up operation up to full power.

Additionally, the ex-core neutron flux instrumentation is qualified to perform under accident conditions of up to 159°C, 6 barabs, 100% relative humidity and 1,1 MGy radiation dose.

- Framatome provides all services for a reliable ex-core neutron flux measurement chain including qualification of sensors, hardware, software beside training of your personnel, recurrent testing and full maintenance.
- Framatome's ex-core neutron flux instrumentation is designed for simple operation, easy diagnostics and maintenance while providing the highest level of safety



Ex-core neutron flux measurement ranges versus their possible application

Customer benefits

- Tailor-made ex-core neutron flux instrumentation
- Qualified up to severe accident conditions
- Simple operation and easy to maintain
- Training of personnel up to full-support including maintenance activities
- Reactimeter – reduction of start-up operation by up to 75%
- Software filtering of neutron flux noise

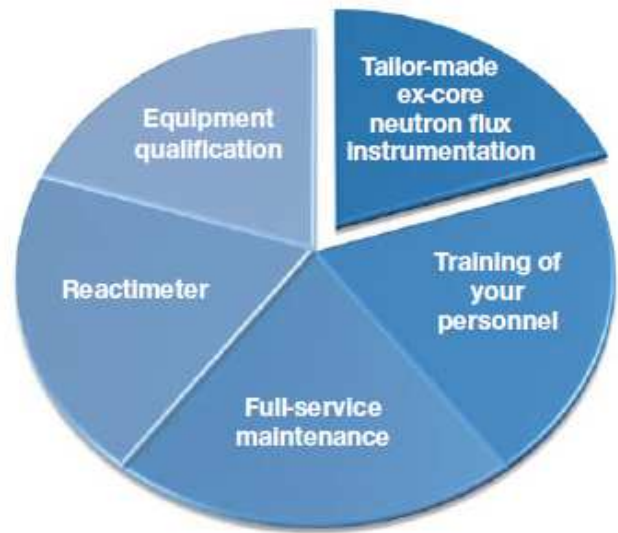
**Your performance
is our everyday commitment**

Technical information

Qualified combinations adjustable to plant specific needs

A variety of qualified combinations of coaxial cable assemblies, detectors and analog or digital signal conditioning can be offered to meet plant specific requirements.

- Coaxial cables (super-screened, low noise, metal sheath mineral-insulated)
- Connectors (HN, coaxial)
- Detectors (counter tubes, ionization chambers w/o gamma compensation, fission chambers)
- Analog or digital signal conditioning including customized software and customized maintenance equipment
- Customized maintenance program and optional on-site support



Key figures

More than **30** years of operational experience in various types of reactors.

Full-service maintenance possible

Training program of maintenance activities for plant personnel

Qualified detectors, cables and connectors

Qualified digital and analog platform for signal processing

Software filtering of neutron flux noise

signals for stable power operation

Significant reduction of start-up time with

reactimeter by up to **75%**



Ex-core container chain

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