framatome

Rod Position Indication

Continuous safety classified measurement, conditioning and calculation of drive rod positions

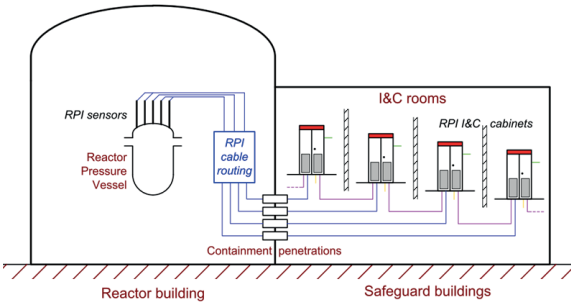
The Framatome Rod Position Indication provides the safety classified analog rod positions used in safety related I&C functions to protect and control a reactor.

Challenge

The Rod Position Indication (RPI) has to provide a continuous, precise and safe measurement of each drive rod position. RPI sensors and connecting lines are installed on Reactor Vessel Head and K1 qualified according to RCCE.

The RPI provides signal to reactor protection and reactor control. Therefore, the RPI is designed to fit with safety related I&C functions (category A according to IEC 61226) and has to meet a high level of reliability.

A smart design of RPI components is necessary to meet the best standards, permitting continuous operation during the nuclear power plant life time with easy testing and maintenance.



Rod Position Indication installation in the power plant

Solution

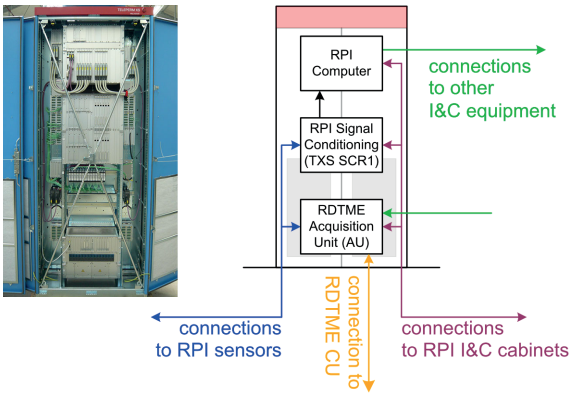
The RPI is composed of three distinct parts; the sensors, the conditioning and the calculations/transmission components.

Expectations of the reactor control for safety and accuracy are applied to the drive rod actual position, and performed directly on the reactor pressure vessel.

In order to achieve the highest reliability in harsh environment, the components are manufactured with durable materials and a failure-defensive design. The components and materials are qualified to the Reactor Building environment (K1 in RCCE) for the complete lifetime of the plant (60 years).

The RPI solution uses the highly reliable safety-classified TELEPERM XS (TXS). Each of the TXS-based RPI cabinets integrate power supply modules for sensors and complete conditioning of analog signals. The conditioned data are distributed to a dedicated RPI software running on a TXS computer for calculation and distribution to the Protection System (PS) and Reactor Control, Surveillance and Limitation System (RCSL).

The Framatome Rod Drop Time Measurement Equipment (RDTME) is a testing tool necessary to record the measurements of rod drop dynamic properties. The RDTME is integrated in the RPI solution but not safety classified.



Detailed view of one RPI I&C cabinet with interfaces

Customer benefits

- With long-term experience in installation and maintenance around the world, TELEPERM XS I&C safety platform brings increased system reliability
- Better performance with self monitoring and reliability of proven TELEPERM XS I&C equipment that can be customized
- Licensing certainty: RPI fulfills functional safety class 1, I&C quality class E1A, seismic requirements O and seismic class 1

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

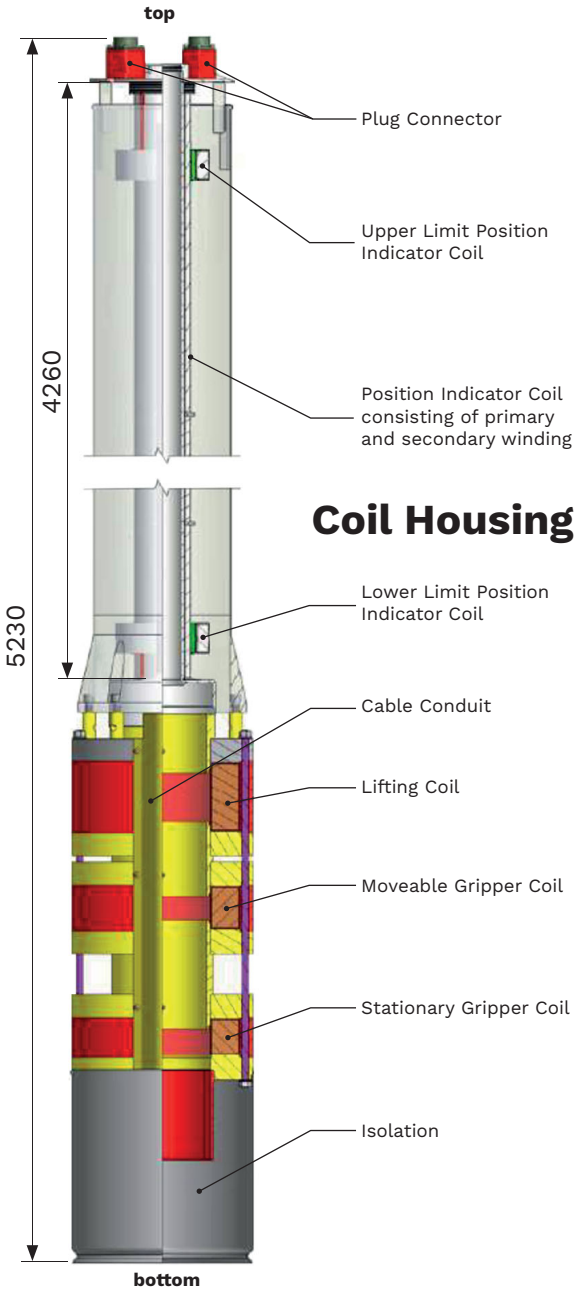
Options and available configurations

As the experienced product designer and integrator, Framatome has the capacity to customize the solution to any client need.

The following different scenarios are usually considered:

- New plants:
  - Complete Framatome RPI solution

  Or
  - Integration of Framatome RPI component in an existing solution. e.g. use the conditioning and processing with other sensor solution
- Refurbishment of an existing RPI-like system:
  - Partial replacement of the system, targeting only the parts to be replaced



CRDM (Control Rod Drive Mechanism) - RPI subcomponents

Technical information

Qualification, reliability and maintenance

- Safety class 1 (F1A) and Seismic class 1 in accordance to IEC 61226
- Easy maintenance of all major system parts and components is supported by extensive self-tests and auto-diagnostics functions

RPI I&C cabinets

- Width x Depth x Height [mm]: 900 x 400 x 2200
- Depth with doors [mm]: 450
- Weight empty/full [kg]: approx. 190/max. 410
- Power supply [V]: 24, for the maximum current [A]: 9
- Theoretical dissipation power [W]: <=500
- Operating temperature (Room cond.) [°C]: 15 ... 30
- Humidity (Room cond.) [%]: 30 ... 70

Rod position measurement channel

- Number of rod position indicator measurements: 89
- Response time [s]: <3 s
- Accuracy: 5% of core height (21 cm or 21 steps)

Ambient conditions of RPI components – containment

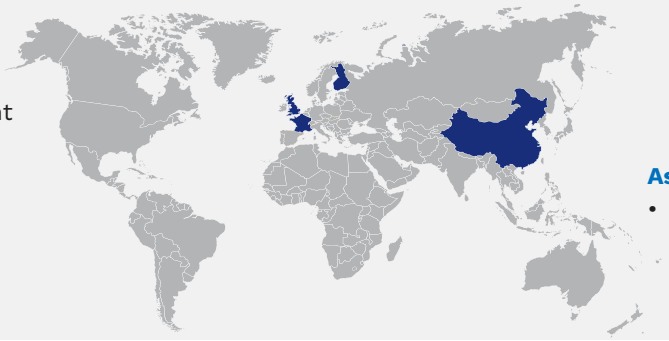
- Operating temperature (Room cond.) [°C]: 15 ... 60
- Operating pressure (Room cond.) [mbar]: 860 ... 1060
- Radiation [kGy]: 250

References

Framatome has deployed its RPI measurement systems in EPR reactors in:

Western Europe

- France
- Finland
- United Kingdom



Asia

- China

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