Instrumentation & Control Systems for the RMB

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The Brazilian Multipurpose Reactor (RMB) is meant to be an open pool type multipurpose nuclear reactor with a nominal power of 30 MW. This report shows a summary description of RMB Instrumentation and Control (I&C) systems. The I&C system follows the IAEA safety classification [1].
Modern I&C systems are based on the use of digital technology, distributed control systems and the integration of information in data networks (Distributed Control and Instrumentation Systems). This has a repercussion on Control Rooms (CRs), where the operations and monitoring interfaces correspond to these systems. The RMB I&C follows this approach [2]. The I&C system (Figure 1) is composed by:

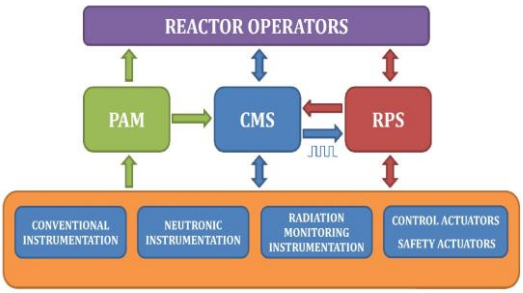

Figure 1. RMB I&C systems block diagram.

- Reactor Protection Systems (RPS) that includes all electrical and mechanical devices and circuits for the First, and Second Reactor Protection Systems (FRPS and SRPS). These generate signals associated with protective functions that are carried out by the safety actuation systems. Both the FRPS and SRPS are Engineered Safety Features and Safety Category 1 Systems.
- Post Accident Monitoring System (PAM) includes all electrical components required to monitor conditions of the facility during and after an accident.
- Plant Control and Monitoring System (CMS) includes all the components required for reactor process control, monitoring during normal operation and plant incidents. It is the main interface for plant operations through the Main Console (MC) in the Main Control Room (MCR). CMS includes an extensive number of signals and systems; therefore it is divided into several subsystems, such as the Reactor Control and Monitoring System (RCMS), Facilities Control and Monitoring System (FCMS), and other subsystems to control different plant facilities.
- Reactor operators use the MCR area where reactor and associated systems are normally controlled by graphical interfaces.

All nucleonic parameters handled by the FRPS and SRPS come from the Nucleonic Channels. They consist of neutron flux and nitrogen-16 gamma detection instruments that supply information to the RPS and PAM system, describing the state of the reactor regarding neutron production and its evolution. The neutron flux measurement is based on fission chambers, wide range fission chambers, and compensated ionization chambers which are able to monitor neutron flux for the whole operational range of the reactor. There is an overlap between the channels, as well as an adequate margin able to measure flux above the full power level for the unlikely event of a power excursion. The nucleonic instrumentation comprises 3 Start-up Channels, 3 Wide Range Logarithmic Channels, 3 Power Channels, a Wide Auto-range Linear Channel, and a Nitrogen-16 Linear Channel.
The RPS, PAM and RCMS include neutronic instrumentation channels to cover the neutron flux over the whole range of the operation of the reactor: from source level up to 125% of full power level. To comply with safety and reliability requirements, each parameter of the FRPS (start-up channel and wide range logarithmic channel) and SRPS (power channel) is measured by three redundant channels, which are entirely independent from the detector of the electronic measuring modules. Additionally the SRPS and FRPS trains, in which these channels are located, are diverse and share no instrumentation in common.

References

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