Detailed design of the Instrumentation and Control Systems of the Brazilian Multipurpose Reactor - RMB

P.V.R. Carvalho[1], M. S. Farias[1], I. J. A. L. Santos[2], F. Lacerda[1], G. D. G. Jaime[2], C. H. S. Grecco[2]
E-mail: paulov@ien.gov.br, msantana@ien.gov.br, luquetti@ien.gov.br, flacerda@ien.gov.br, gdjaime@ien.gov.br, grecco@ien.gov.br

[1]*SEINS, IEN;* [2]*SEESC, IEN*

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RMB will be an open pool reactor that uses beryllium as reflector and heavy water as both moderator and cooling fluid. The reactor has a capacity of 30 MW, and its key requirements are: radioisotope production, to meet national demand; production of thermal and cold neutron beams for research and application in all scientific fields; material and nuclear fuel production for Brazil's nuclear program; neutron activation analysis; and silicon transmutation doping [1]. This report summarizes the work completed during the detailed design phase for the instrumentation and control (I&C) system. The project uses the OPAL research reactor in Australia as a conceptual model. OPAL was developed and built by INVAP, an Argentine technology company that also worked on the RMB project in partnership with Amazul and CNEN. During the detailed project, approximately 800 I&C documents were certified. Digital technologies, distributed control systems, and information integration in data networks are all used in modern I&C systems (Distributed Control and Instrumentation Systems). This has an impact on Control Rooms (CRs), where these systems' operations and monitoring interfaces are located. This is how the RMB I&C operates. The I&C system (Figure 1) consists of the following components:

- Reactor Protection Systems (RPS), which encompasses all electrical and mechanical devices and circuits for the First and Second Reactor Protection Systems (FRPS & SRPS). These generate signals related to the protective functions performed by the safety actuation systems. The FRPS and SRPS are Safety Category 1 Systems.
- Post Accident Monitoring System (PAM), which includes all electrical components required to monitor conditions of the facility during and after an accident. The PAM is Safety Category 2 System.
- The CMS (Plant Control and Monitoring System) contains all the components needed for reactor process control, monitoring during normal activity and plant incidents. The Main Console (MC) in the Main Control Room (MCR) is the primary interface for plant operations.

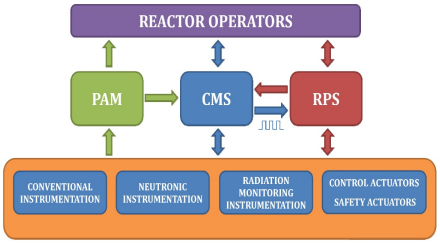

Figure 1. RMB I&C systems block diagram.

The MCR area is where operators monitor the reactor and related systems using graphical interfaces. The Nucleonic Channels are the source of all nucleonic parameters treated by the FRPS and SRPS. They derive from up of neutron flux and nitrogen-16 gamma detection instruments that feed data to the RPS and PAM systems, describing the reactor's state and evolution in terms of neutron generation. The neutron flux is measured using wide range fission chambers and compensated ionization chambers that can track neutron flux over the reactor's entire operating range. Different technologies are used by the FRPS and SRPS. In RMB, FRPS adopts digital processing modules that are qualified for nuclear applications and are based on a PLC platform. The protective functions are: protection interlocks, Trip 1 (fast insertion of control rods) and reconfiguration of Reactor Confinement Ventilation Systems. Only hard-wired technology is used in the SRPS. The Trip 2 action (opening the valve to drain the tank of heavy water) and second Trip 1 action, if the FRPS fail, are protective functions associated with this mechanism. With the conclusion of the detailed project, construction of the RMB is expected to begin in 2022.

References

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