

# Brazilian Multipurpose Reactor





## Introduction

The Brazilian Multipurpose Reactor (RMB) Project is an action of the Federal Government, through the Ministry of Science Technology and Innovation (MCTI) and has its execution under the responsibility of the Brazilian National Nuclear Energy Commission (CNEN). Within the CNEN, the project is coordinated by the Research and Development Directorate (DPD) and developed through research units of this board being the Institute of Nuclear Energy Research (IPEN the main developer.

The Nuclear Reactor RMB will be an open pool type reactor with maximum power of 30 MW having the OPAL nuclear reactor of 20 MW, built in Australia, as a reference. The RMB reactor core will have a 5x5 configuration, consisting of 23 fuel elements of U<sub>3</sub>Si<sub>2</sub> dispersion-type in aluminum, having a density of up to 3.5 gU/cm<sup>3</sup> and enrichment of 19.75 wt% of U-235. Two positions will be available in the core for materials irradiation devices. The main objectives of the RMB Reactor and the other nuclear and radioactive facilities are:

- Production of radioisotopes and radiopharmaceuticals in order to meet the Brazilian domestic demand, including molybdenum-99 for the technetium-99m generators, which is the most widely used radioisotope in nuclear medicine;
- Nuclear fuels and structural materials irradiation testing and post-irradiation analysis;
- Development of scientific and technological research using neutron beam.

All facilities and associated infrastructure to the RMB Project are located in an area of about 200 hectares in the county of Iperó, state of São Paulo, 125 km from the center of Sao Paulo city. This area is neighbor to the ARAMAR Experimental Center (CEA) operated by the Navy Technological Center in São Paulo (CTMSP).

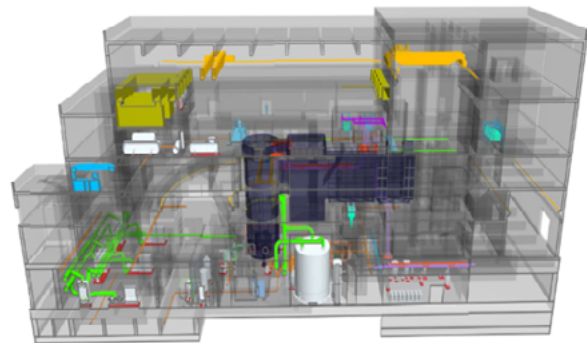
The RMB project management organization set the life cycle into three different phases: phase 1- Implementation; phase 2 - operation; and phase 3- decommissioning. The implementation phase of RMB project has the following steps: **(i) site setup**; **(ii) conceptual design**; **(iii) basic (or preliminary) engineering design**; **(iv) detailed (or executive) engineering design**; **(v) procurement and contracts**; **(vi) construction**; **(vii) fuel assembly development and manufacture**; **(viii) nuclear and environmental licensing**; and **(ix) commissioning**. For each step, there are management plans and resources allocated. There is also a strong interaction among the engineering steps and the licensing needs.

A summary of the status of the project development is:

**a) Site setup** – site is defined, topography and ground survey done, meteorological tower installed and pre-operational radiological environment monitoring plan is under regular execution.

**b) Conceptual design** – done. CNEN Institutes technicians developed the conceptual engineering design of the research reactor, laboratories, main facilities and infrastructure.

**c) Basic engineering design** – done. The Ministry of Science, Technology Innovation and Communication (MCTIC) granted CNEN with financial resources for the basic engineering design of the RMB project. It allowed, in 2012, the signature of a contract with INTERTECHNE, a Brazilian company, to develop the engineering work for the preliminary design phase of all buildings, facilities and infrastructure of the new center. In 2013, CNEN signed a contract with INVAP for the work related to the basic engineering of the reactor and connected systems. Both contracts ended in November 2014. Almost seven thousand engineering documents were produced up to this point of implementation.



Reactor Building

**d) Detailed engineering design** - The MCTIC granted CNEN with financial resources for the detailed engineering design of the RMB research reactor in the end of 2014. Difficulties related to the financial liberation of the resources, and difficulties for contracting an engineering company led the CNEN to sign an cooperation agreement with Amazonia Azul Tecnologia (AMAZUL), a state company operating in the nuclear sector to support CNEN in the detailed design and the engineering implementation of the project. A term of reference for the work was already done and contracts are under negotiation with INVAP, in a similar way as in the basic design step.

**e) Fuel assembly development and fabrication** - The MCTIC granted CNEN with financial resources for the fuel assembly development and improvement of the existing fabrication infrastructure. This package includes the production of a plate type entire core for the IPEN/MB-01 critical facility. This will be the reactor physics laboratory for the RMB reactor.

**f) Environmental license** - Environmental licensing process has started in 2012. MRS, a Brazilian Company, prepared the Environmental Impact Analysis (EIA) for the RMB center. IBAMA (Environment Regulatory Authority) analyzed and approved the RMB EIA. CNEN sponsored three public hearings in two cities near the RMB site (Iperó and Sorocaba), and in Sao Paulo city. IBAMA has granted RMB Project with the first environmental license (Initial License) in May 2015. CNEN has already started the actions to prepare the environmental plans for the IBAMA installation license authorization. With this license, it will be possible to initiate the field infrastructure actions for the construction step. RMB Project got also the license for using the water from a river located near the site

for industrial operational needs, and water from the underground for human use.

**g) Nuclear license** - Nuclear licensing process started. CNEN Institutes technicians elaborated the Site Evaluation Report (SER). The Nuclear License Authority (DRS/CNEN - Directorate of Radioprotection and Safety of CNEN) analyzed the SER and approved it. The DRS/CNEN granted RMB Project with the Site License in January 2015. CNEN Institutes technicians are now elaborating the Preliminary Safety Analysis Report (PSAR) of the RMB research reactor.

IPEN technical staff, as the main project developer, contributed significantly for RMB development. IPEN had the leadership for conceptual design, for nuclear licensing process, for the environmental licensing process, for the basic engineering design verification, for administrative matters, quality management process and for fuel fabrication process.



- 1 Nuclear Research and Production Area
- 2 Administrative Area
- 3 Infrastructure Area
- 4 Electrical Station
- 5 RMB Entrance



- 1 NRPA Entrance
- 2 Researchers Bld.
- 3 Workshop Bld.
- 4 Waste Processing and Storage Bld.
- 5 Electrical Supply Bld.
- 6 Cooling Towers
- 7 Reactor Auxiliary Bld.
- 8 Reactor Bld.
- 9 Spent Fuel Bld.
- 10 Post Irradiation Lab.
- 11 Radioisotope Processing Bld.
- 12 Radiochemistry Lab.
- 13 Operator Support Bld.
- 14 Neutron Beam Lab.

