Brazilian Multipurpose Reactor Project (RMB)

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RMB Project

Ministério da Ciência, Tecnologia e Inovação

FIFA WORLD CUP
Brasil

Rio2016

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Sirius - Brazilian Synchrotron


RMB
Reator Multipropósito Brasileiro

Plano de Trabalho 02.Abril.2013
Convênio CNPEM-CNEN

Today

LNLS - Brazilian Synchrotron

1997
Energy: 1.37 GeV
14 beamlines

IEA-R1

1957
Power: 4.5 MW
2 instruments

Sirius - Brazilian Synchrotron

2018
Energy: 3 GeV
40 beamlines


RMB
Reator Multipropósito Brasileiro

Plano de Trabalho 02.Abril.2013
Convênio CNPEM-CNEN

2018
Power: 30 MW
18 instruments

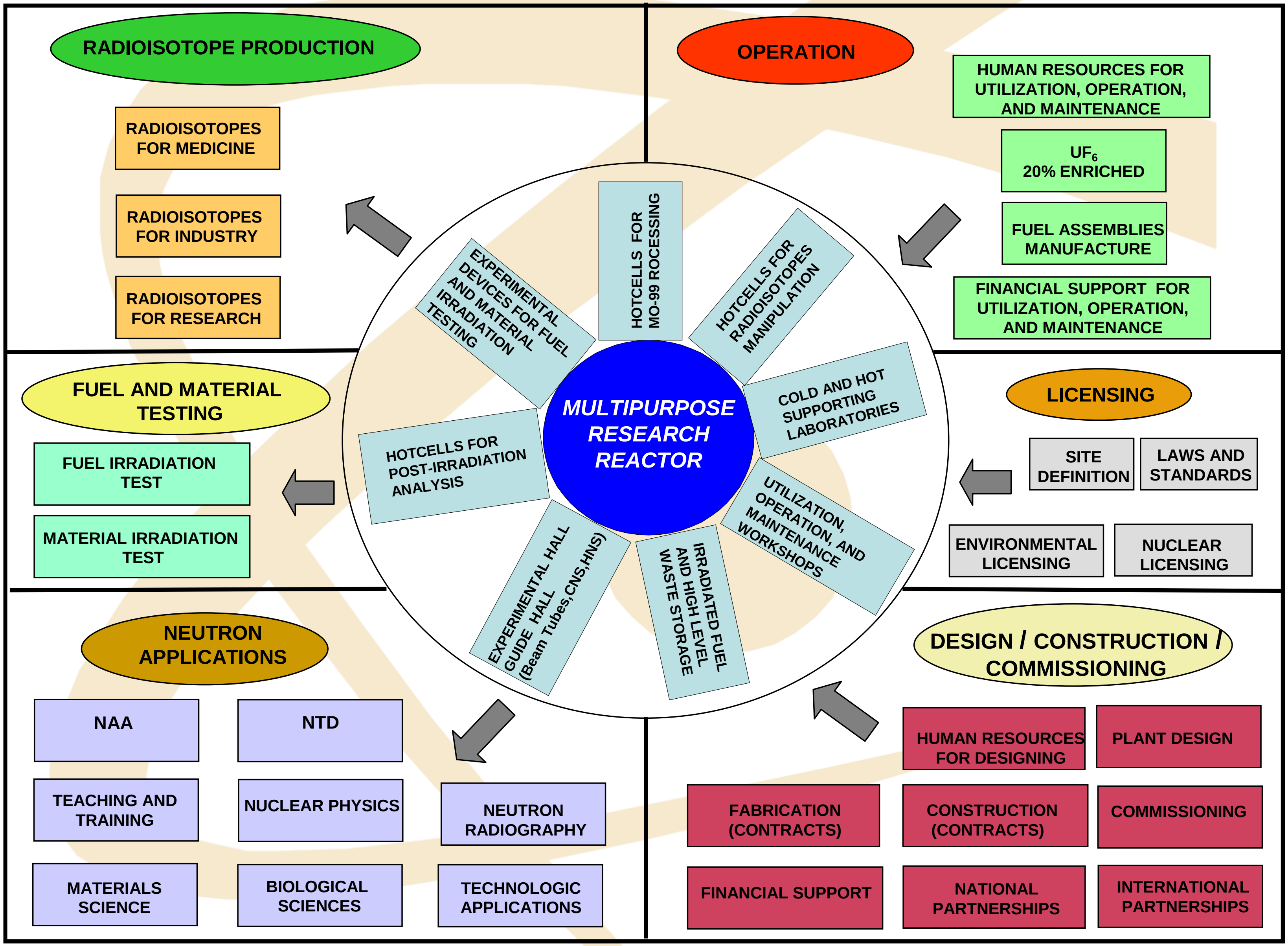
RMB Project

Brazilian Multipurpose Research Reactor (RMB)

Main Functions

- Radioisotope Production for Medical and Industrial Applications
- Fuel and Materials Irradiation Testing
- Neutron Beam Scientific and Technological Research
- Education and Training

RMB Project Scope



Reactor Characteristics

- Open pool multipurpose research reactor with a primary cooling system through the core – OPAL RR as a reference model for conceptual design.

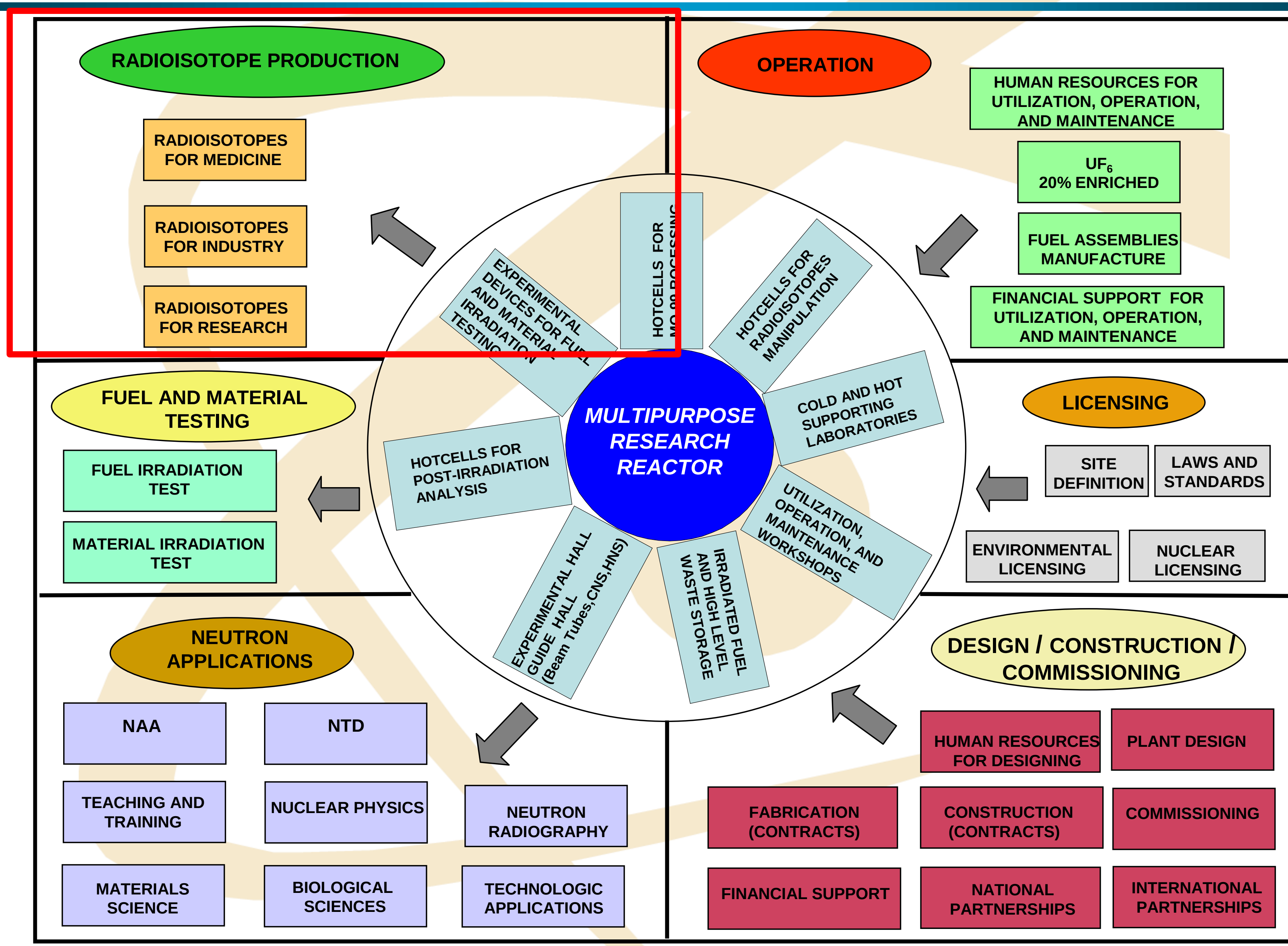
- The reactor core will be compact, using MTR fuel assembly type, with planar plates, U_3Si_2-Al dispersion fuel with maximum 4,8 gU/cm^3 density and 20 % U-235 enrichment.

- The reactor core will be cooled and moderated by light water, using heavy water as reflector and light water and/or beryllium in one side of the core .

- Neutron flux (thermal and fast) higher than $2x10^{14}$ $n/cm^2.s$.

- Maximum Thermal Power - 30 MW

RMB Project Scope



Radioisotope Production

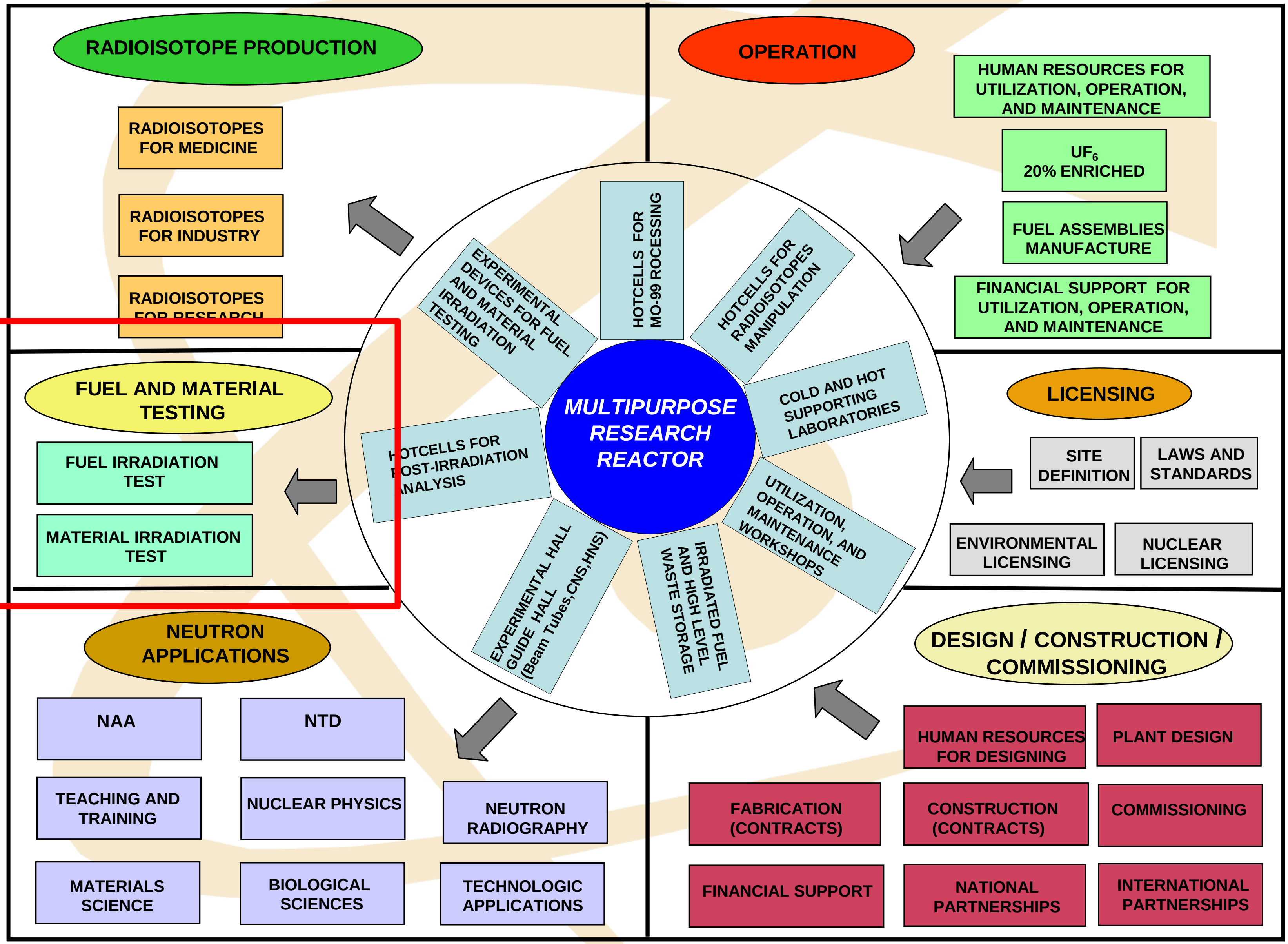
- **Radioisotope for Injectable Radiopharmaceuticals**
  - ^{99}Mo , ^{131}I, ^{51}Cr, ^{153}Sm, ^{177}Lu, ^{166}Ho, ^{90}Y, ^{188}W, ^{32}P
    - ✓ ^{99}Mo obtained by LEU target irradiation and processing
    - ✓ 1000 Ci/week (Today 350 Ci/week imported by IPEN and 450 Ci/week before the international crisis)
- **Radioisotope for Brachtherapy**
  - ^{125}I, ^{192}Ir
- **Radioisotope for Industry**
  - ^{192}Ir, ^{60}Co
- **Tracers**
  - ^{203}Hg , ^{131}I, ^{82}Br

Radioisotope Production

Infrastructure

- Processing hot cells for irradiated U targets (LEU) to produce ^{99}Mo and ^{131}I;
- Hot cells for handling and transport preparation of produced radioisotopes;
- Special hot cells for radioactive sources processing and sealing;
- Hot cell and special devices for ^{125}I production;
- Shielded casks for radioisotope transportation;
- Irradiation devices for in core and in reflector radioisotope production;

RMB Project Scope



Nuclear Fuel and Materials Irradiation Test

Materials	Test Objective
Nuclear Fuels	Fuel Performance Characterization and Specification Optimization
Structural Materials	Life Extension of Nuclear Power Plants Characterization of Materials and Performance under Irradiation
All	Safety Analysis

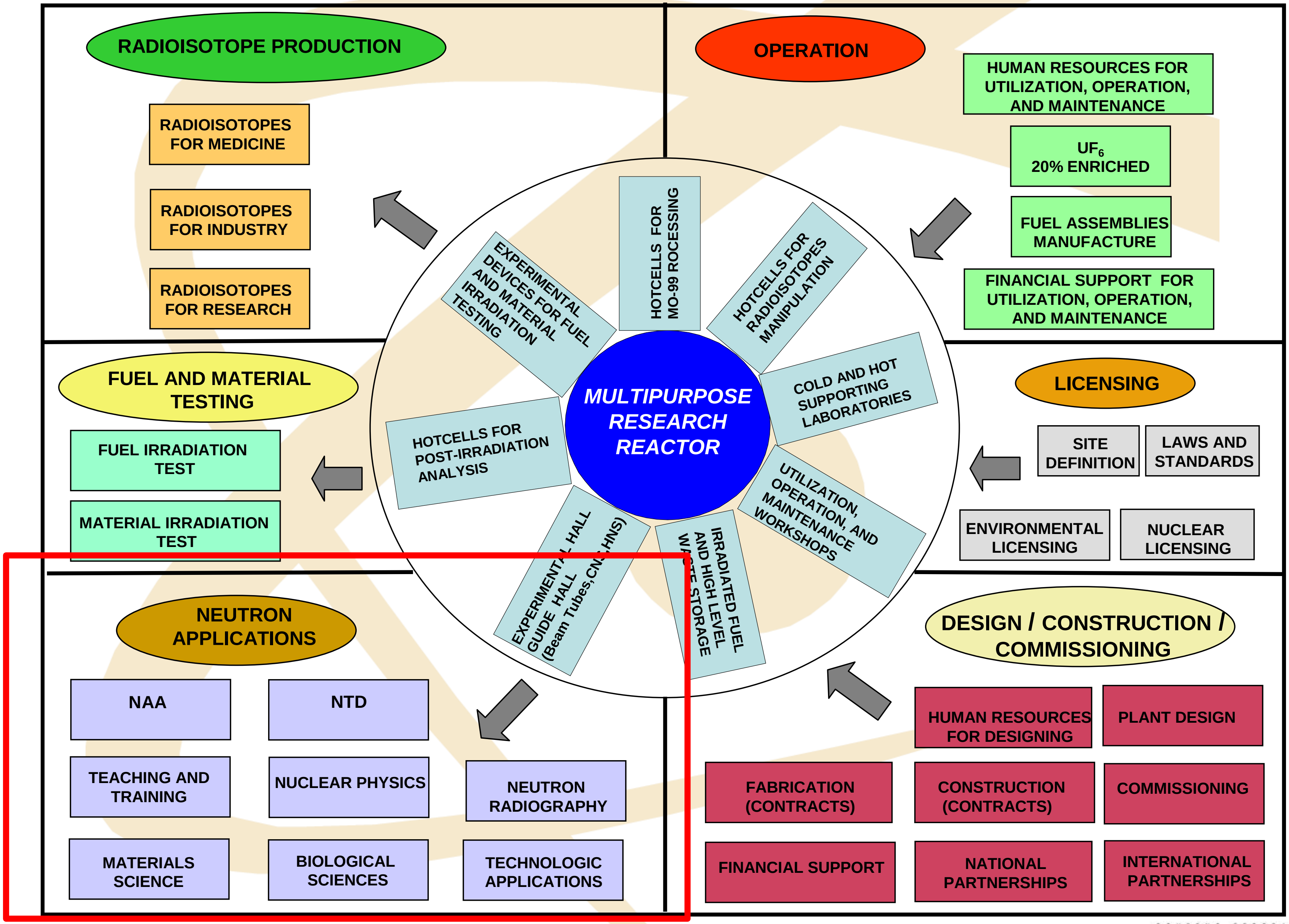
Irradiation Systems

- Pressurized irradiation loops for fuel testing with pressure and cooling temperature control
- Irradiation capsules for fuel specimens testing
- Horizontal displacement devices for simulating power ramps and loading following
- Irradiation capsules with temperature control for structural materials testing
- Irradiation experiments control room and data collection systems
- Experimental devices for underwater nondestructive analysis (visual inspection, gamma scanning, sipping, etc)

Post-irradiation Examination

- One hot cell laboratory for irradiated fuel and one hot cell laboratory for irradiated materials examination
- The hot cells laboratory shall allow:
  - Nondestructive physical characterization analysis of irradiated specimens
  - Puncturing and fission gas collection
  - Sample preparation for metallographic analysis
  - Optical microscopy
  - Physical and mechanical properties characterization equipment

RMB Project Scope



CNEN Comissão Nacional de Energia Nuclear
Ministério da Ciência, Tecnologia e Inovação
GOVERNO FEDERAL BRASIL PAÍS RICO E PAÍS SEM POBREZA

Neutron Beam Utilization

Neutron beam group:

Fabiano Yokaichiya
Margareth Franco
Francisco Souza

- To allow the possibility of at least three beam holes (today proposed 5)
- To project two beam holes with neutron guides: one for thermal and one for cold neutrons. Each beam hole shall have capacity for at least 2 neutron guides (today with 3 guides)
- The technical characteristics of each beam hole (dimensions and position) will be established during the preliminary design of the reactor.
- Each beam hole shall have a flux higher than:
  - $1x10^9$ n/cm^2.s outside the reactor shielding; or
  - $1x10^{14}$ n/cm^2.s at the point of tangency near the core.

Neutron Beam Utilization

Initial Equipment Proposal

Thermal Neutrons Beam	
Guide Hall	**Experimental Hall**
High Resolution Diffractometer	Triple-Axis Spectrometer
High Intensity Diffractometer	Neutron radiography
Reflectometer	
Time-of-Flight Spectometer	
Cold Neutrons Beam	
Small Angle Neutron Scattering	
Prompt Gamma Analysis	

Neutron Beam Utilization

Initial Equipment Proposal

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Time-of-Flight Spectometer	
Cold Neutrons Beam	
Small Angle Neutron Scattering	
Prompt Gamma Analysis	

Neutron Activation Analysis

- Neutron Activation Analysis at irradiation positions with thermal neutron flux in the range of 10^{11} to 10^{13} n/cm^2.s.
- One irradiation position with cadmium filter for epithermal neutrons activation.
- Pneumatic stations with transit time of 10 seconds, and one very fast station with transit time less than 10 seconds for analysis of radioisotopes with very high decay constant.
- Pneumatic stations for transportation of samples (long irradiation) from core to the radiochemical laboratory.
- Fission delayed neutron measurement system for samples containing U and Th.

Project Management

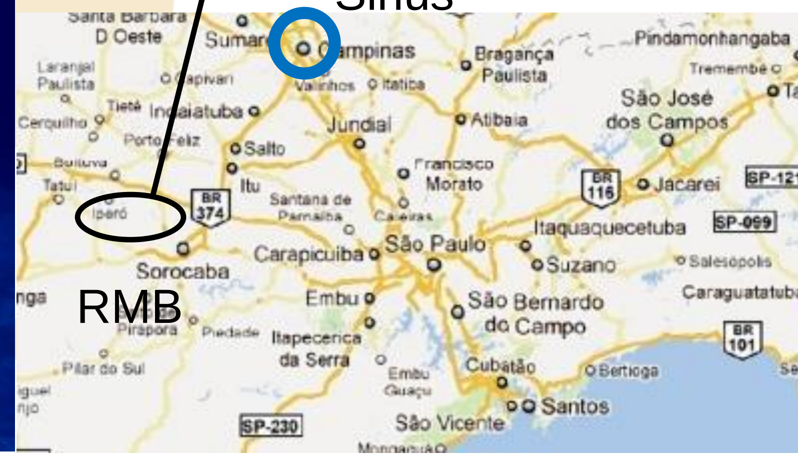
- Project managed by the Research and Development Directorate of the Brazilian Nuclear Energy Commission (DPD-CNEN)
- Scope and preliminary design, licensing process managing and commissioning verification performed by the Research Institutes of CNEN: IPEN, CDTN, IEN, CRCN
- CNEN – CNEA (Argentina) Cooperation Agreement on Reactor Design of RMB and RA-10 based on INVAP / Opal design
- Basic and detailed design, manufacturing, construction, assembling and their management will be carried out by national and international companies.
- Project technically supported by Brazilian Academy
- Project Cost estimation of US$ 500 million (R$ 1000 million)
- Project time span of at least 6 years after the first contract signature and availability of funds. (2013)

Site

ARAMAR - IPERÓ

Iperó
State of São Paulo

Sirius



RMB

Comissão Nacional de Energia Nuclear

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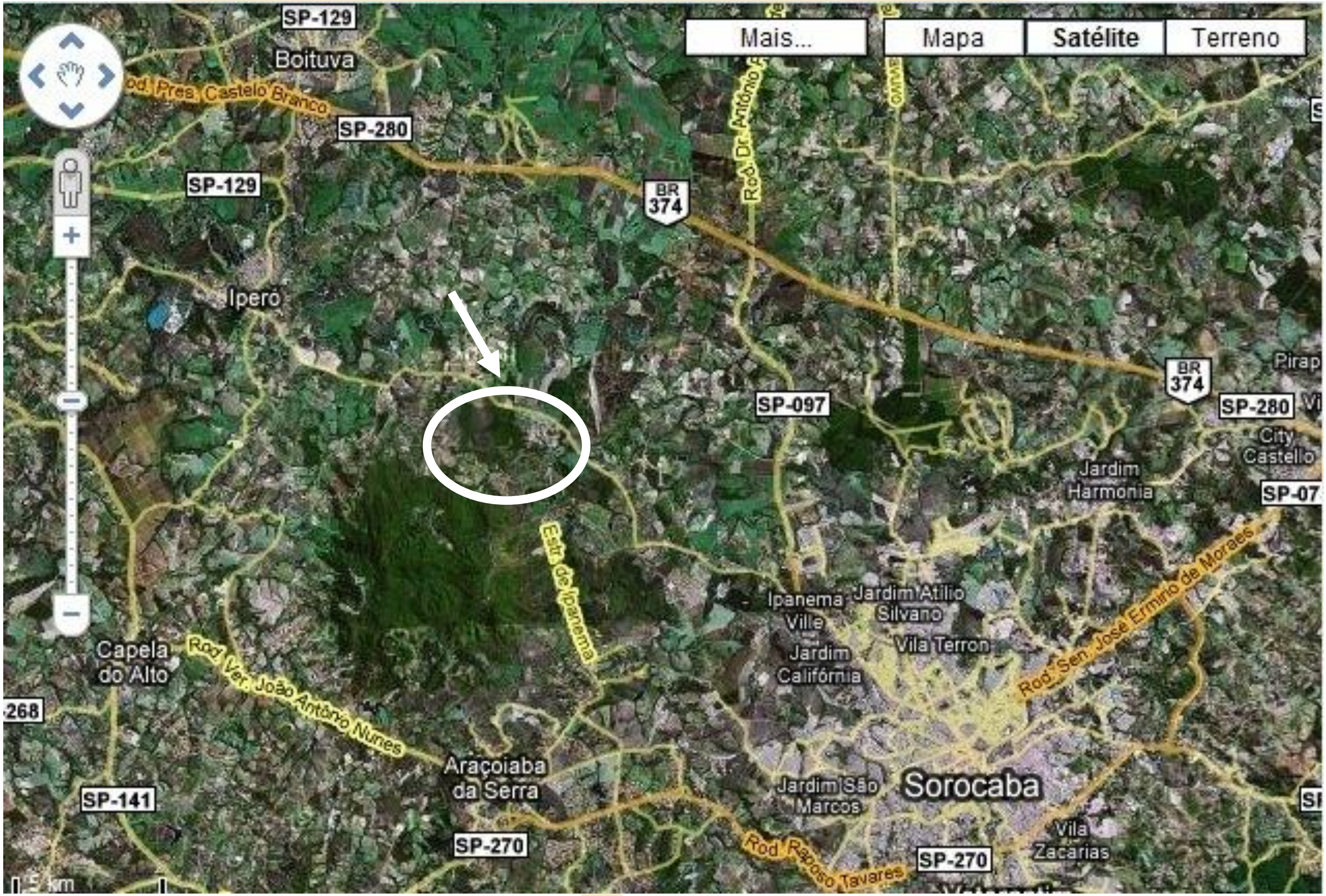
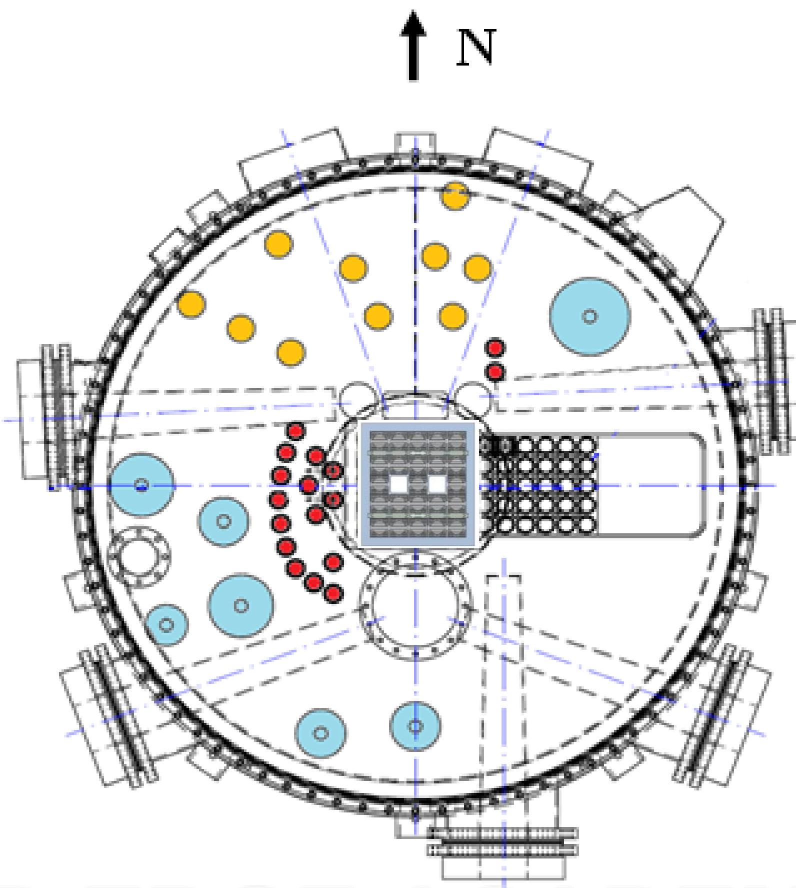
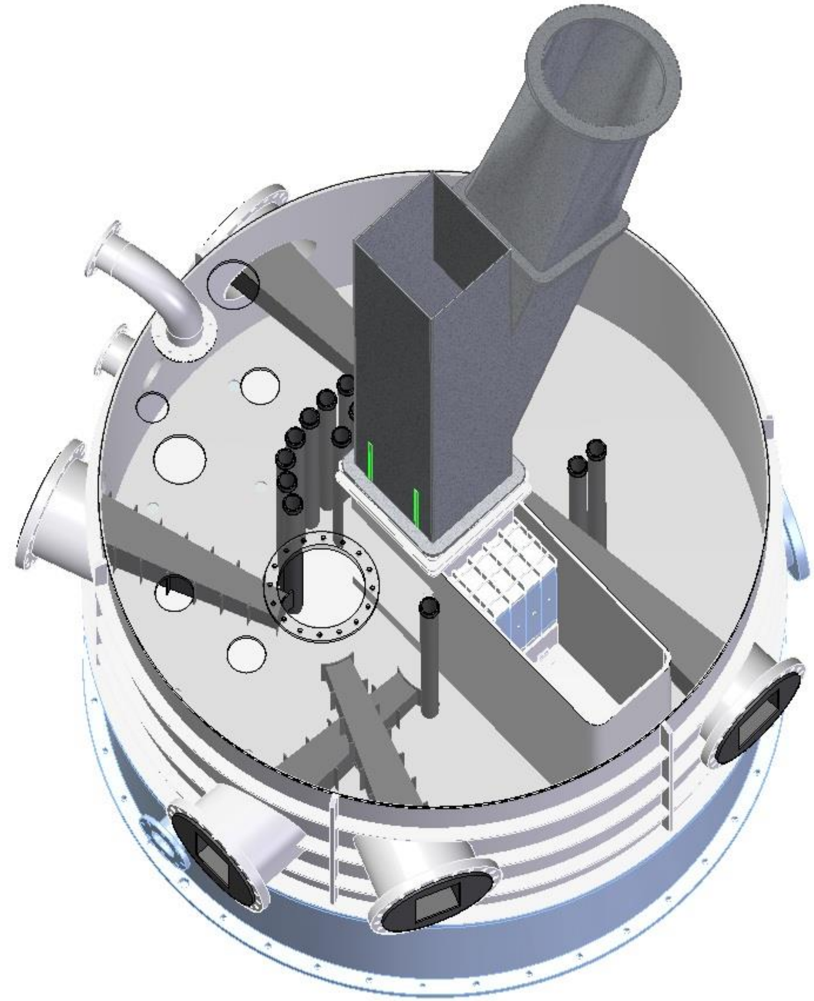
Site


Mais...
Mapa
Satélite
Terreno
SP-129
Boituva
Rod. Pres. Castelo Branco
SP-280
SP-129
BR 374
Rod. Dr. Antônio
Iperó
SP-097
BR 374
SP-280
City Castello
Jardim Harmonia
SP-07
Estr. de Ipanema
Ipanema Ville
Jardim Atílio Silvano
Vila Terron
Jardim Califórnia
Rod. Sen. José Ermírio de Moraes
Capela do Alto
Rod. Ver. João Antônio Nunes
268
SP-141
Araçoiaba da Serra
SP-270
Jardim São Marcos
Sorocaba
Rod. Raposo Tavares
SP-270
Vila Zacarias
5 km

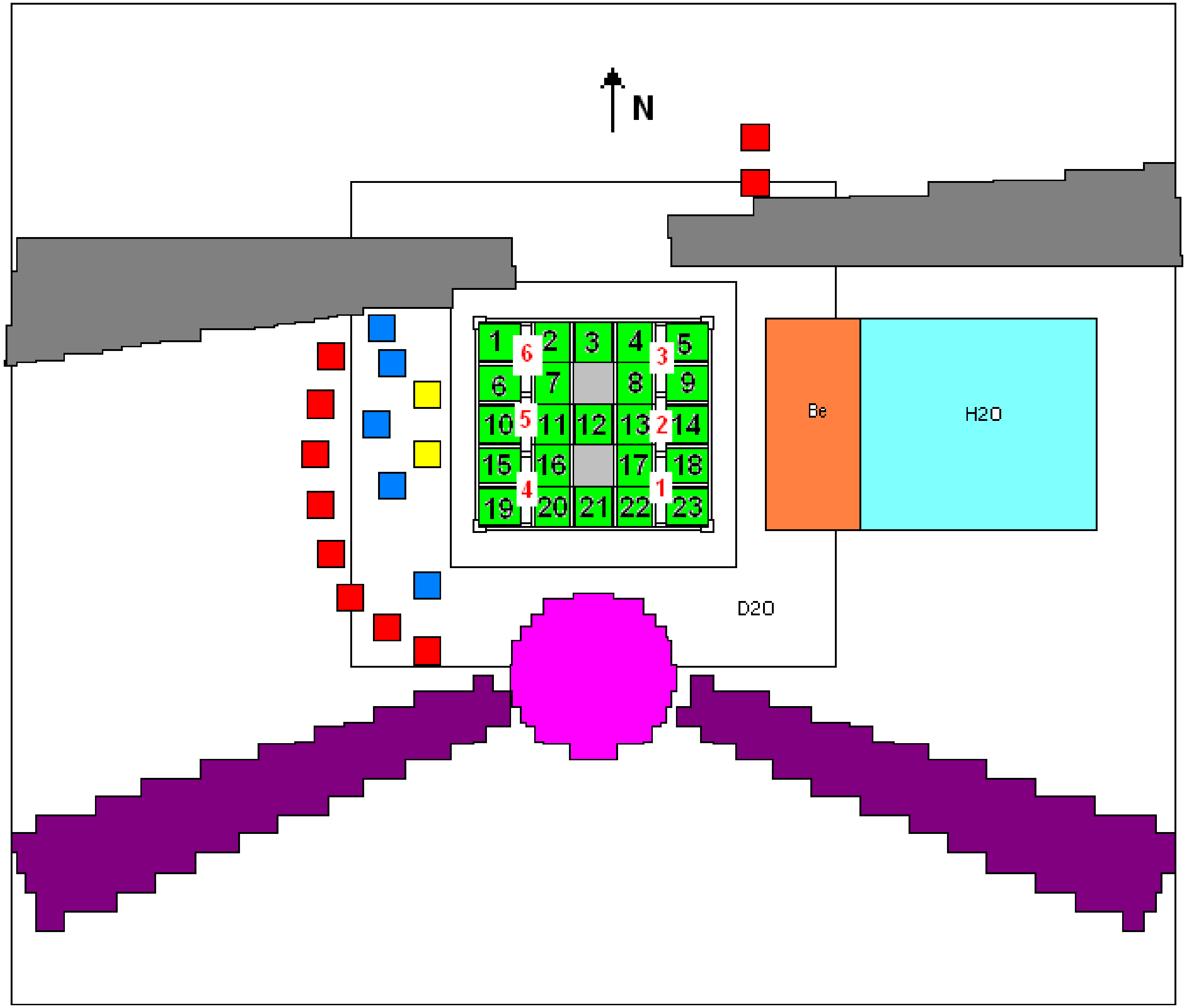
RMB Reactor





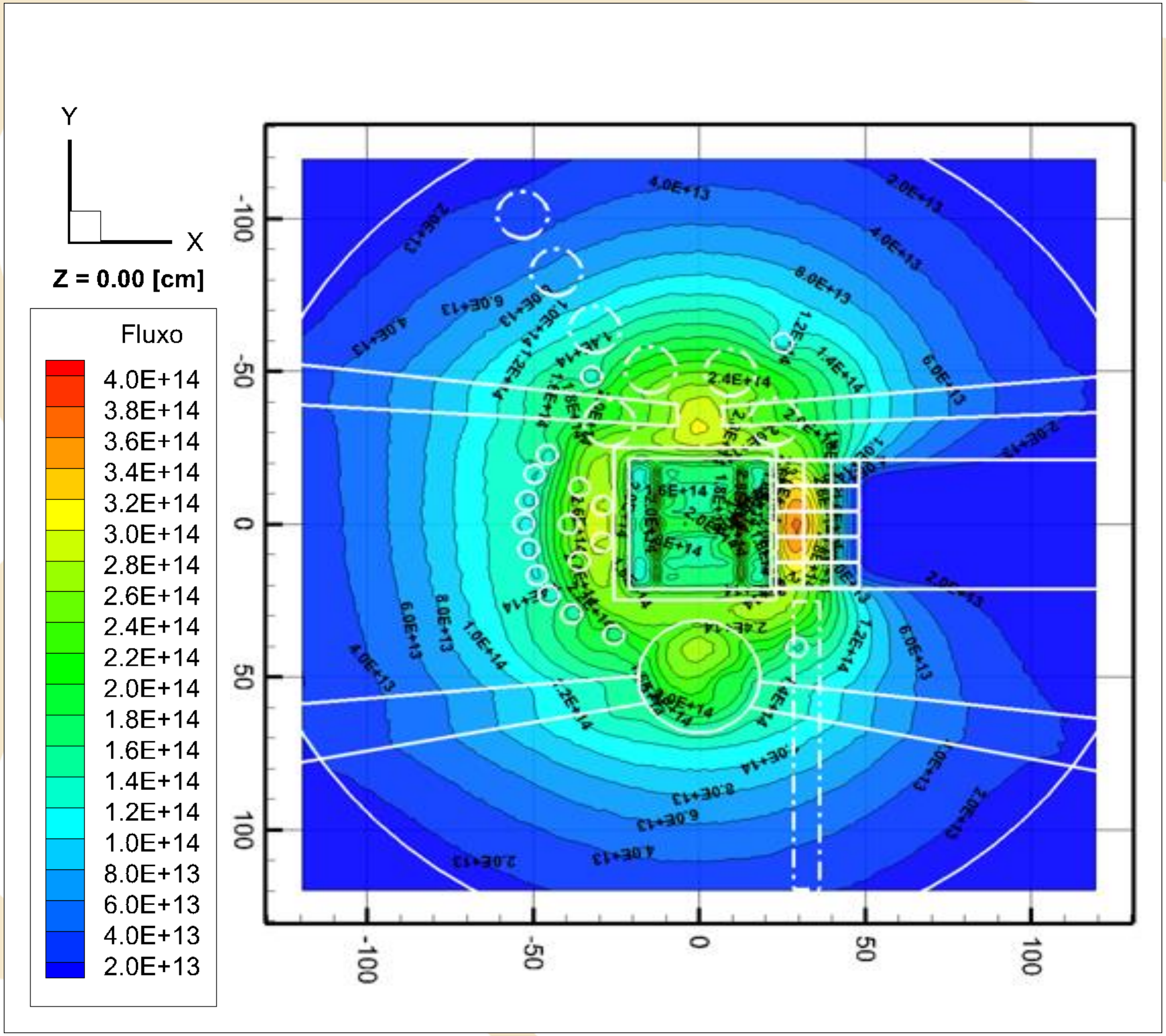
- Bulk irradiation position
- Pneumatic irradiation position
- NTD irradiation position

RMB Reactor



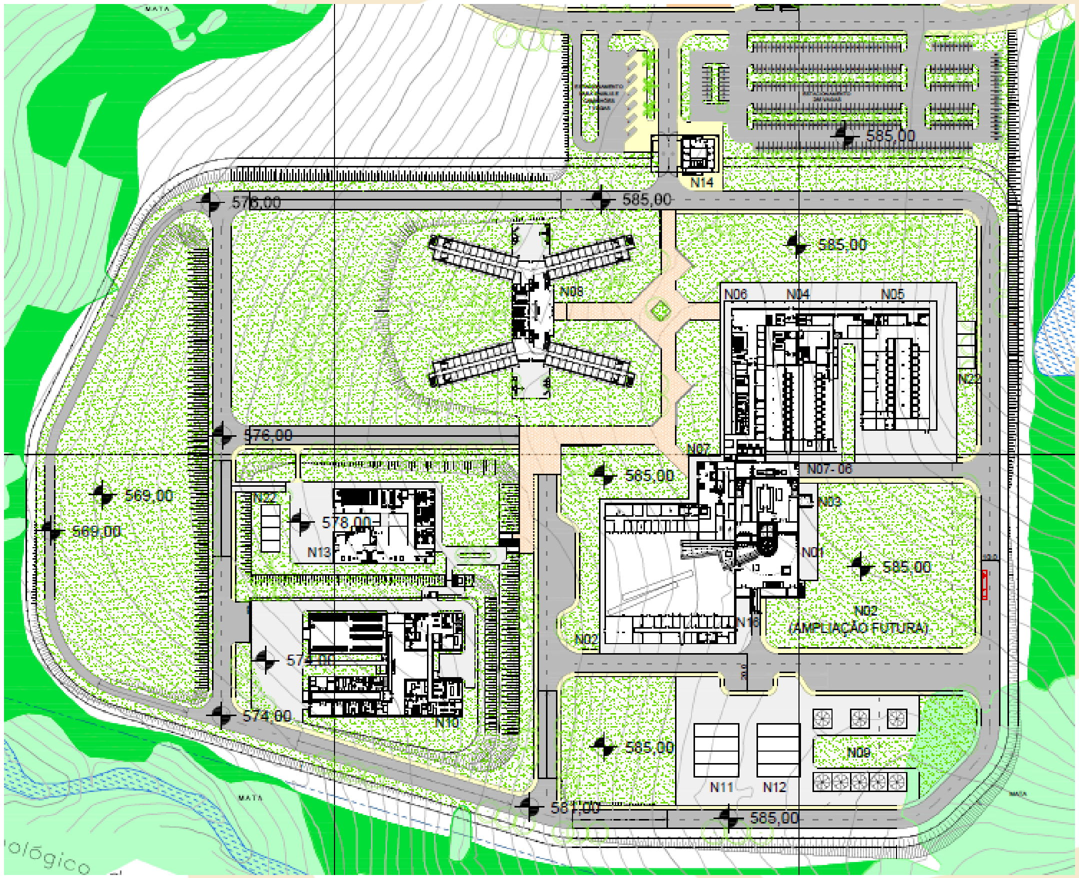
Heavy water
Fuel Elements
Fast Flux Facilities
Cold Neutron Source
Cold Beams
Thermal Beams
Beryllium Reflector
Water behind Berylium
Molybdenum
Industrial Iridium / Others
Medicinal iridium / Lutetium

RMB Reactor



Y
X
Z = 0.00 [cm]
Fluxo
4.0E+14
3.8E+14
3.6E+14
3.4E+14
3.2E+14
3.0E+14
2.8E+14
2.6E+14
2.4E+14
2.2E+14
2.0E+14
1.8E+14
1.6E+14
1.4E+14
1.2E+14
1.0E+14
8.0E+13
6.0E+13
4.0E+13
2.0E+13
-100
-50
0
50
100

RMB Buildings



- N01 – Reactor
- N02 – Neutron Beam Laboratory
- N03 – Spent Fuel and Material Handling
- N04 – Radioisotope Processing
- N05 – Post-Irradiation Laboratory
- N06 – Radiochemistry Laboratory
- N07 – Operation Office
- N08 – Researchers Offices
- N09 – Cooling Towers
- N10 – Waste Treatment and Storage
- N11,N12 – Electrical Cabins
- N13 – Workshop
- N14 – Access Control

RMB Buildings

Thank you!