RMB
THE NEW BRAZILIAN MULTIPURPOSE RESEARCH REACTOR

CURRENT STATUS AND PERSPECTIVES

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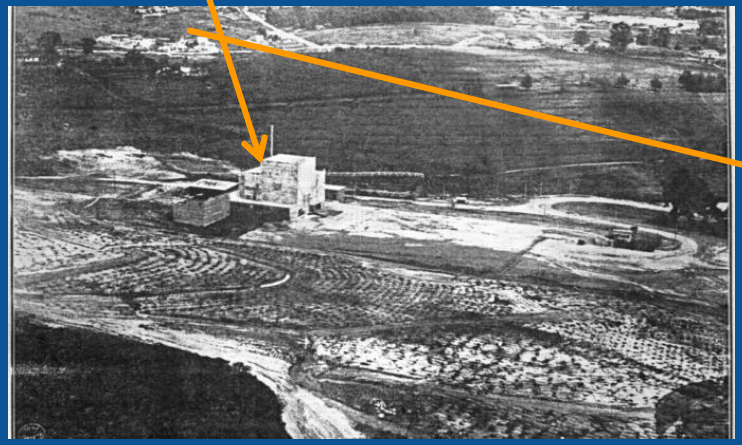
RESEARCH REACTORS IN BRAZIL

Ministério da Ciência, Tecnologia e Inovação

Name	Utilization	Power	Site	Startup	Type
IPEN/MB-01	Critical facility – PWR Core analysis	100 W	IPEN/CNEN-SP São Paulo	1988	Open Core - Pin Type
ARGONAUTA	Research -Education	500 W	IEN/CNEN-RJ Rio de Janeiro	1965	Argonaut
IPR-R1	Research -Education	100 kW	CDTN/CNEN-MG Belo Horizonte	1960	TRIGA MARK-I
IEA-R1	Research Radioisotope Production	5 MW (2MW)	IPEN/CNEN-SP São Paulo	1957	Reator MTR Piscina Aberta

1957 : IEA → 2014: IPEN/CNENSP



WHY A NEW RESEARCH REACTOR

Ministério da Ciência, Tecnologia e Inovação

- **The RMB will provide Brazil with a key infrastructure to national development activities of the nuclear sector in the areas of social, strategic, industrial, scientific and technological development and application .**

- **Structuring project.**

RMB MAIN FUNCTIONS

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- **Radioisotope Production for Medical and Industrial Applications**
- **Fuel and Materials Irradiation Testing**
- **Neutron Beam Laboratory**
- **NAA Laboratory**
- **Education and Training**

RMB Objectives

Social Application

- National autonomy in producing radioisotopes for application in medicine, industry, agriculture and environment
- Emphasis on Mo-99 production for Tc-99m provision to the nuclear medicine application
- To support the increase of the nuclear medicine application in benefit of the society

RMB is a key factor for supplying $^{99}Mo/^{99m}Tc$ to the nuclear medicine application in Brazil

RMB Objectives

Strategic and Industrial Application

To generate national capacity for testing and qualifying:

- nuclear fuels for power reactors
- new nuclear fuels for research reactors
- materials for nuclear reactors apllication

RMB is a key factor for the autonomous development of nuclear fuel and materials for reactor application

RMB Objectives

Scientific and Technological Development

- To increase the national capacity in R&D in nuclear techniques applications
- To have a Neutron Activation Analysis Laboratory available for the scientific and technical community
- To create a National Laboratory for Neutron Beam Utilization in complement to the National Laboratory of Synchrotron Light (LNLS)

RMB will contribute strongly to S&T&I in Brazil

NEUTRON BEAM LABORATORY

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Sirius – *New Synchrotron Light Laboratory (under project)*

LNLS- Brazilian Synchrotron Light Laboratory (in operation)

RMB a National Laboratory for Neutron Beam Use in complement to the LNLS

REATOR MULTIPROPÓSITO BRASILEIRO-RMB

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Responsibilities

Ministério da Ciência, Tecnologia e Inovação

Ministério da Ciência Tecnologia e Inovação	
Owner	Comissão Nacional de Energia Nuclear - CNEN
Project Responsible	Diretoria de Pesquisa e Desenvolvimento - DPD

ipen · CDTN · ien · IRD · CRCN

Support

CTMSP Centro Tecnológico da Marinha em São Paulo — Tecnologia Própria é Independência

Governo do Estado de São Paulo — Secretaria de Desenvolvimento Econômico, Ciência e Tecnologia

FINEP

AMAZUL

SBF Sociedade Brasileira de Física

RMB PROJECT STATUS

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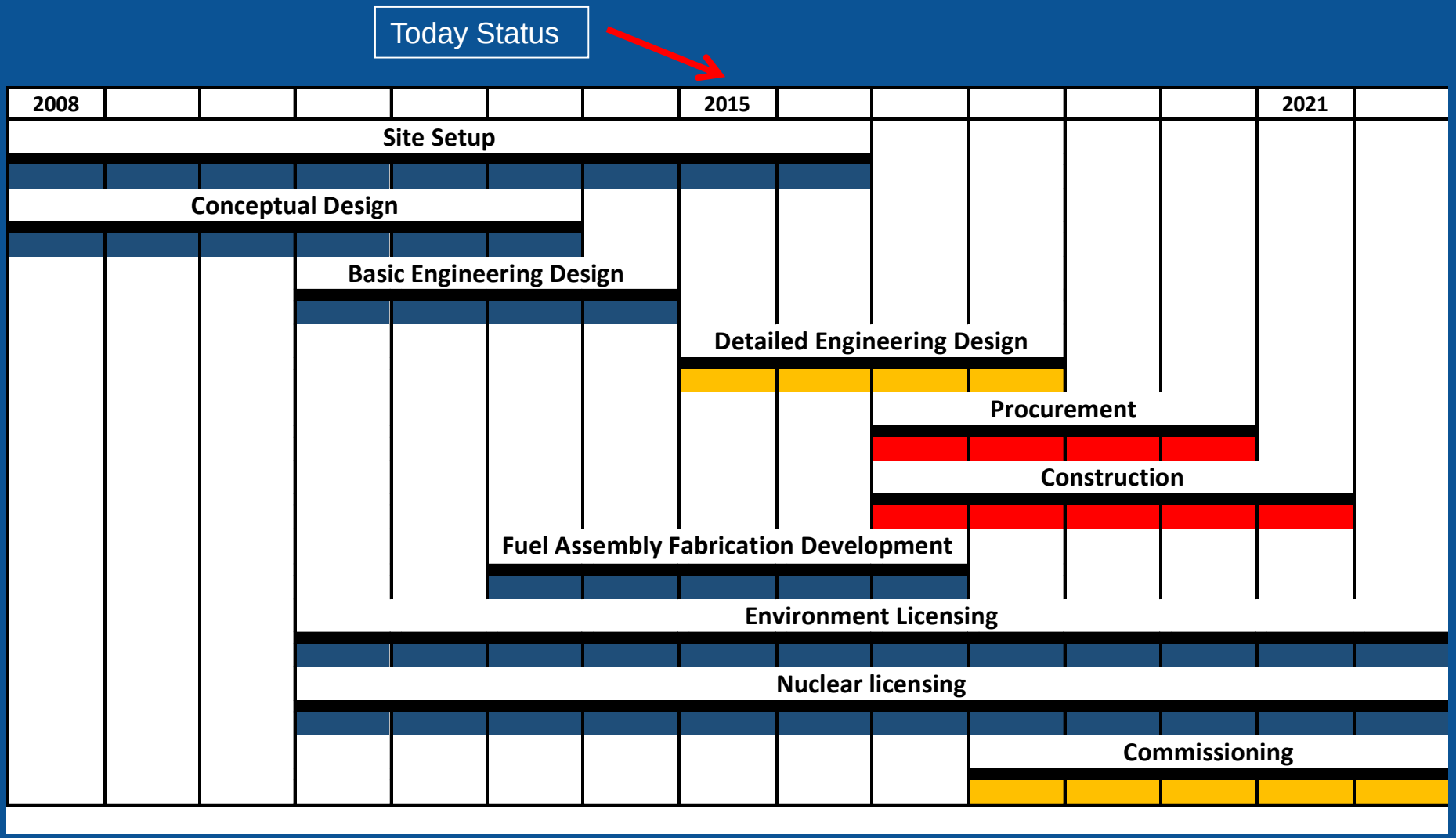
Chronogram



RMB PROJECT STATUS

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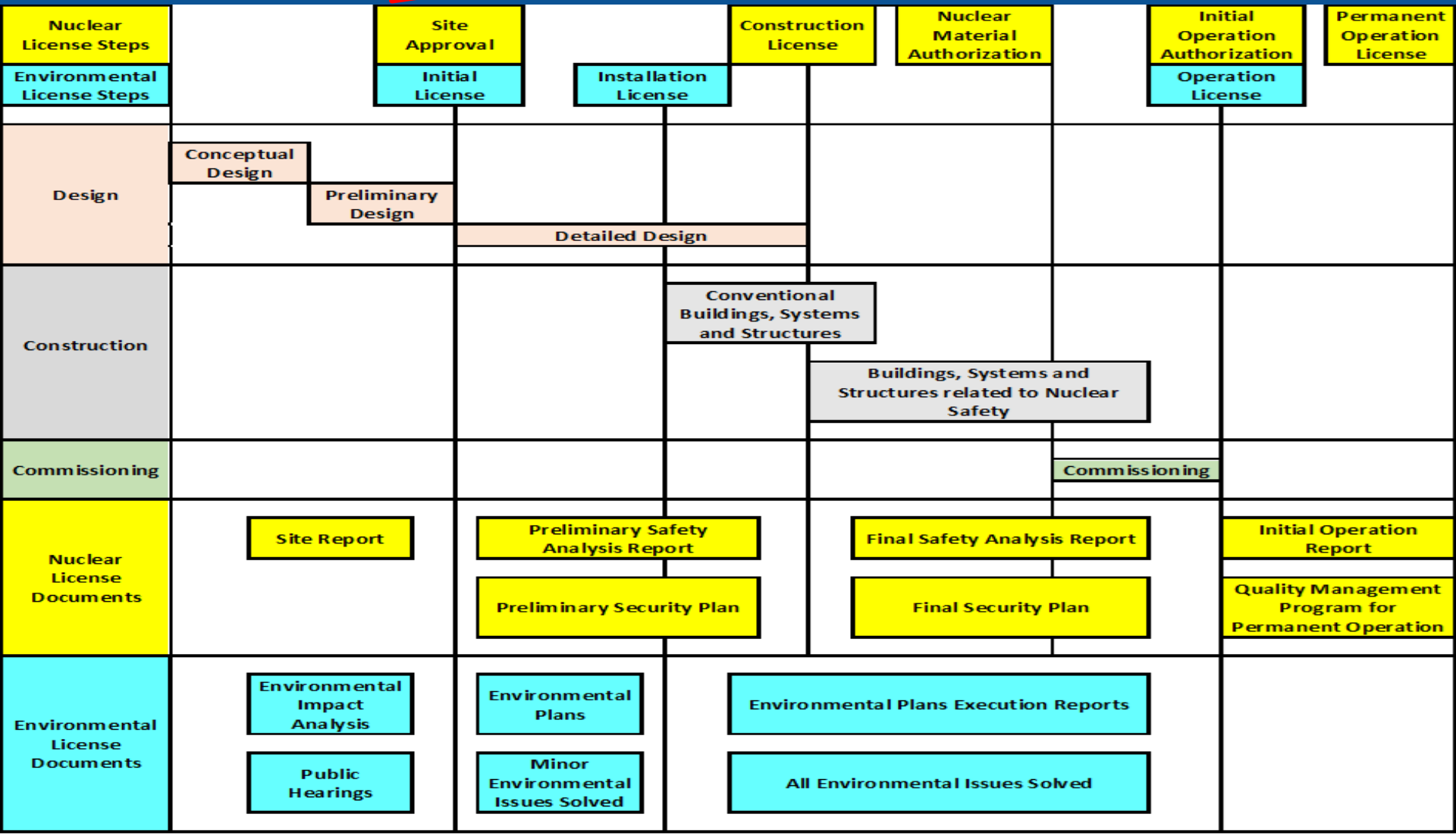
Today Status

Licensing Steps



RMB PROJECT STATUS

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Site setup

- Site defined (2 million m^2) in Iperó, SP
  - 1.2 million m^2 already belongs to CNEN (CTMSP donation)
  - 0.8 million m^2 under expropriation by Sao Paulo State Government
- Topography and ground survey done
- Meteorological tower installed
- Pre-operational radiological environment monitoring plan is under regular execution

RMB PROJECT STATUS

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Conceptual design – ***done***

- CNEN Institutes technicians developed the conceptual engineering design
  - Research reactor
  - Laboratories
  - Main facilities
  - Infrastructure

RMB PROJECT STATUS

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Basic engineering design – ***done***.

- MCTI – FNDCT (FINEP) R$50 M grant
- INTERTECHNE (Brazilian company) - all buildings, systems, facilities and infrastructure
- Brazil-Argentina Agreement (CNEN-CNEA) for common basic engineering design of the RMB and RA-10 (pure nuclear part). OPAL reactor in Australia as a reference
- INVAP (Argentinean company) – research reactor systems and components
- Almost seven thousand engineering documents produced

RMB PROJECT STATUS

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Detailed engineering design

- MCTI – FNDCT (FINEP) R$150 M grant
- Term of reference for the RR detailed engineering design service done
- Service contracting under development

RMB PROJECT STATUS

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Fuel assembly development and fabrication

- MCTI – FNDCT (FINEP) R$25 M grant
- UF_6 supply facility under improvement (CTMSP)
- Fuel fabrication facility under improvement (IPEN/CNEN-SP)
- Production of plate type fuel core for the IPEN/MB-01 critical facility - reactor physics laboratory for the RMB project

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Environmental license

- Environmental licensing process started
- MRS (Brazilian Company) prepared the Environmental Impact Analysis (EIA) for the RMB center
- CNEN sponsored three public hearings in the cities: Iperó, Sorocaba, and Sao Paulo
- IBAMA has granted RMB Project with the first environmental license (Initial License) in May 2015
- RMB Project got also the license for using the water from Sorocaba River, located near the site, and water from the underground aquifer
- Actions to prepare the environmental plans for the IBAMA installation license authorization started

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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.

RMB PROJECT PERSPECTIVES

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Positive Points

- RMB Project included in the Government PPA (2016-2019)
- RMB Project included in the Government PAC
- RMB support from Scientific Societies (ABEN, SBF, SBPMat, SBMN) and Universities
- RMB support from the nuclear community

Negative Points

- Financial resources given as partial values compared to the needs
- Devaluation of the Real currency against the Dollar
- Constant changes of MCTI Minister and staff
- Long time duration the project development

RMB SITE

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Distâncias: (Rota / Linear)
Iperó / São Paulo (140 Km / 109 Km)
Iperó / Sorocaba (50 Km / 39 Km)

N

RMB SITE

Ministério da Ciência, Tecnologia e Inovação

RMB SITE

Ministério da Ciência, Tecnologia e Inovação

GENERAL VIEW

RMB SITE Works

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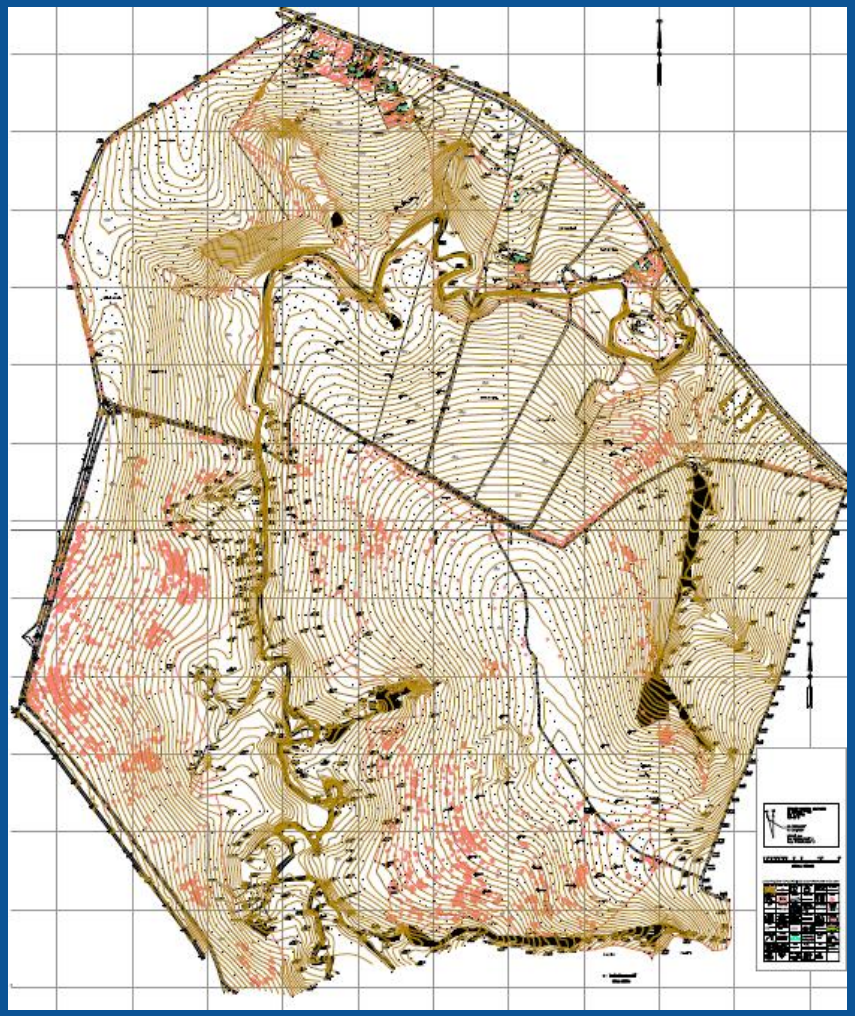
Topography Survey



Ground Survey

Meteorological Tower

RMB SITE Works

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Pre operational Environmental Monitoring

Air Monitoring - Iperó

Air Monitoring - Site

Meteorological Tower Detail

RMB INSTALLATIONS HIGHLIGHTS

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

RMB INSTALLATIONS HIGHLIGHTS

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RMB Main Gate

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Site Services Area

RMB INSTALLATIONS HIGHLIGHTS

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Site Services Area

RMB INSTALLATIONS HIGHLIGHTS

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Administrative Area

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Administrative Area – Administration

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Administrative Area – Auditorium and Education Center

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Administrative Area – Education Center and Library

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Administrative Area – Restaurant

RMB INSTALLATIONS HIGHLIGHTS

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Administrative Area – Medical Center

RMB INSTALLATIONS HIGHLIGHTS

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Nuclear Research and Production Area

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.

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Nuclear Research and Production Area

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Nuclear Research and Production Area

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Ministério da Ciência, Tecnologia e Inovação

Nuclear Research and Production Area

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Nuclear Research and Production Area

RMB INSTALLATIONS HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação

Nuclear Research and Production Area

RMB INSTALLATIONS HIGHLIGHTS

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Nuclear Research and Production Area

RR Core Design Features

- Thermal Power: 30 MW
- Fuel Assemblies: LEU – MTR
- Core configuration: 5 x 5 grid with 23 FAs and 2 in-core irradiation positions
- Control Rods: 6 Hf plates (3 per Guide Box)
- Core Cooling: 3100 m^3/h upward direction

RMB PROJECT HIGHLIGHTS

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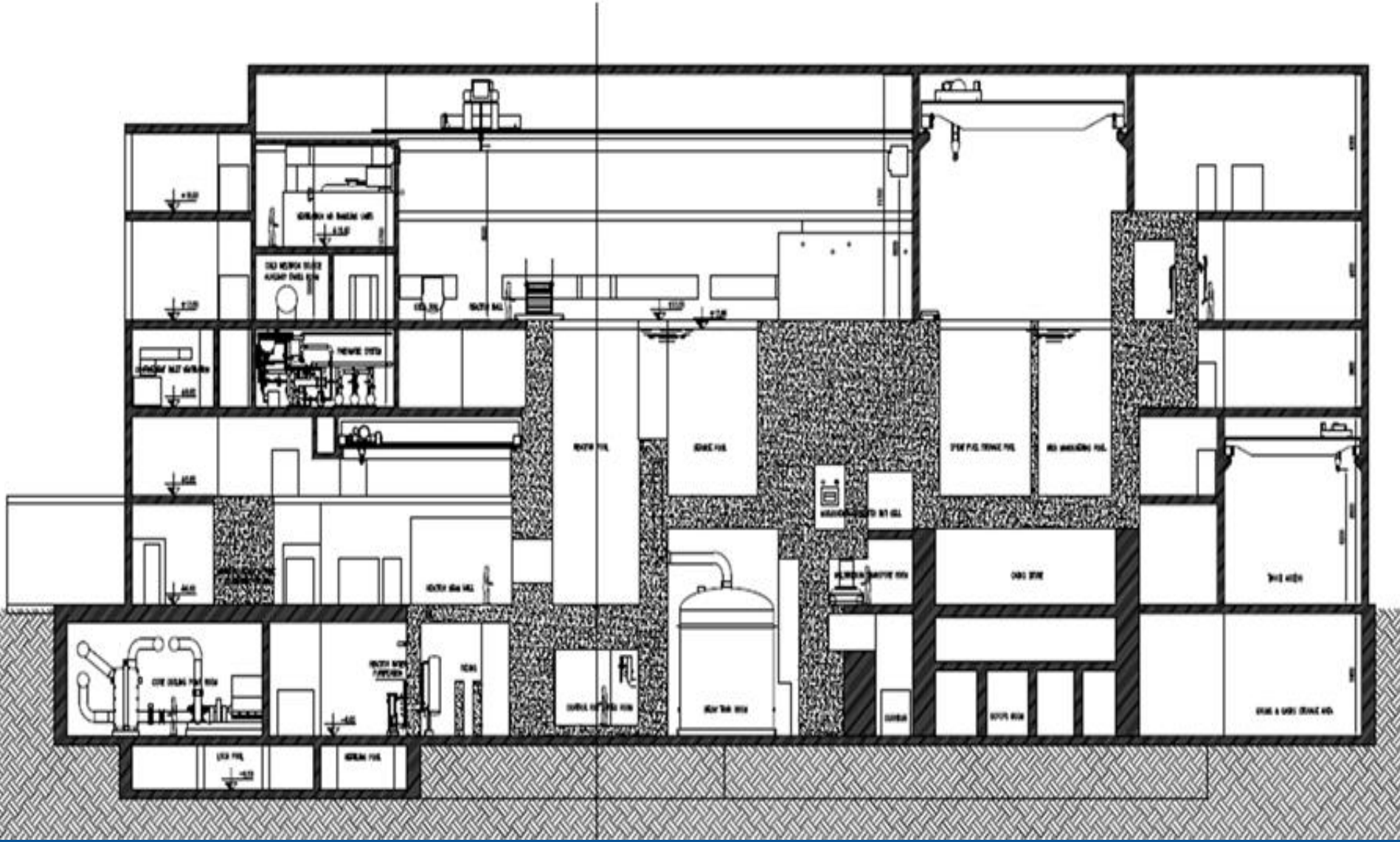
South – North Building Section



RMB PROJECT HIGHLIGHTS

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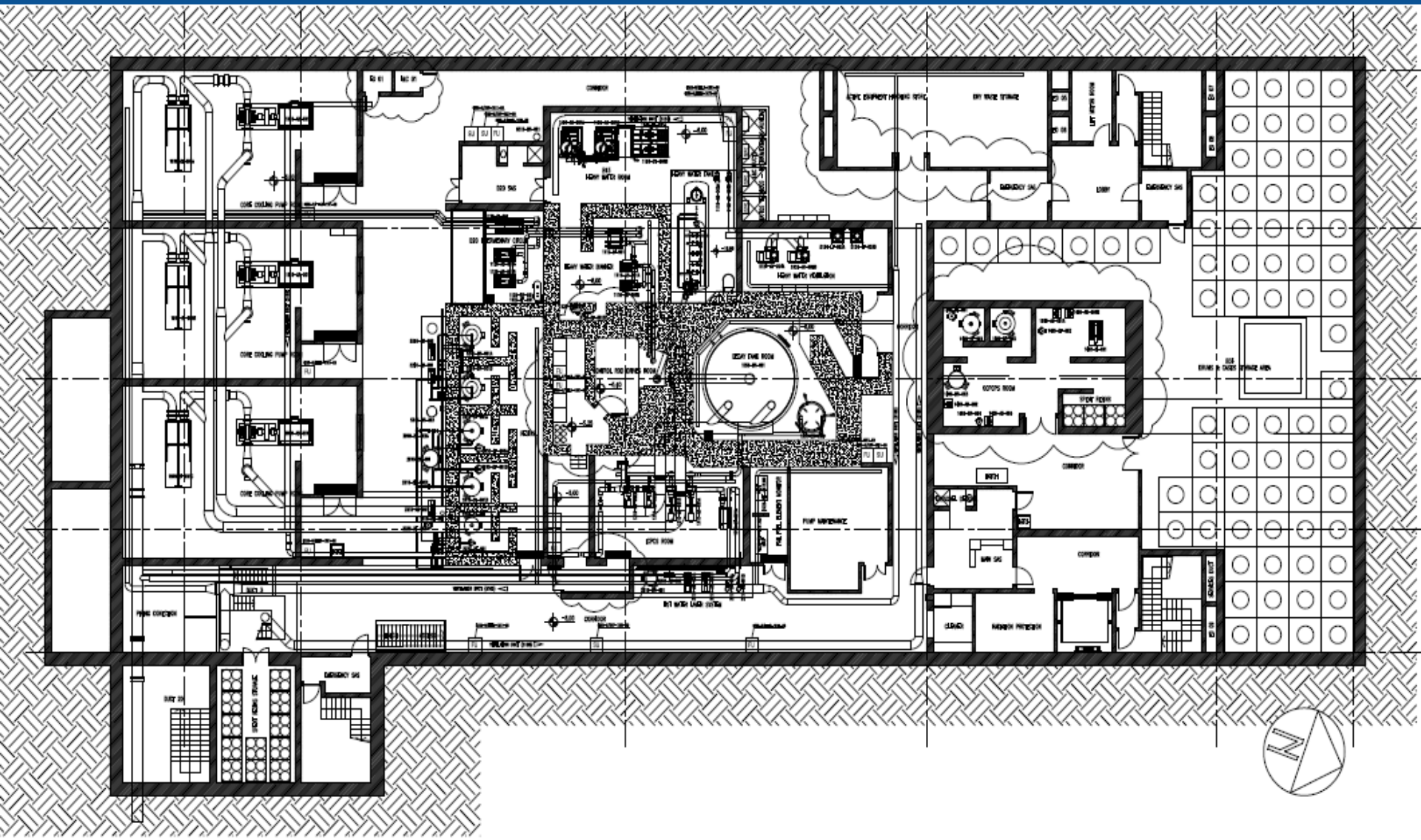
- 6.50 m level



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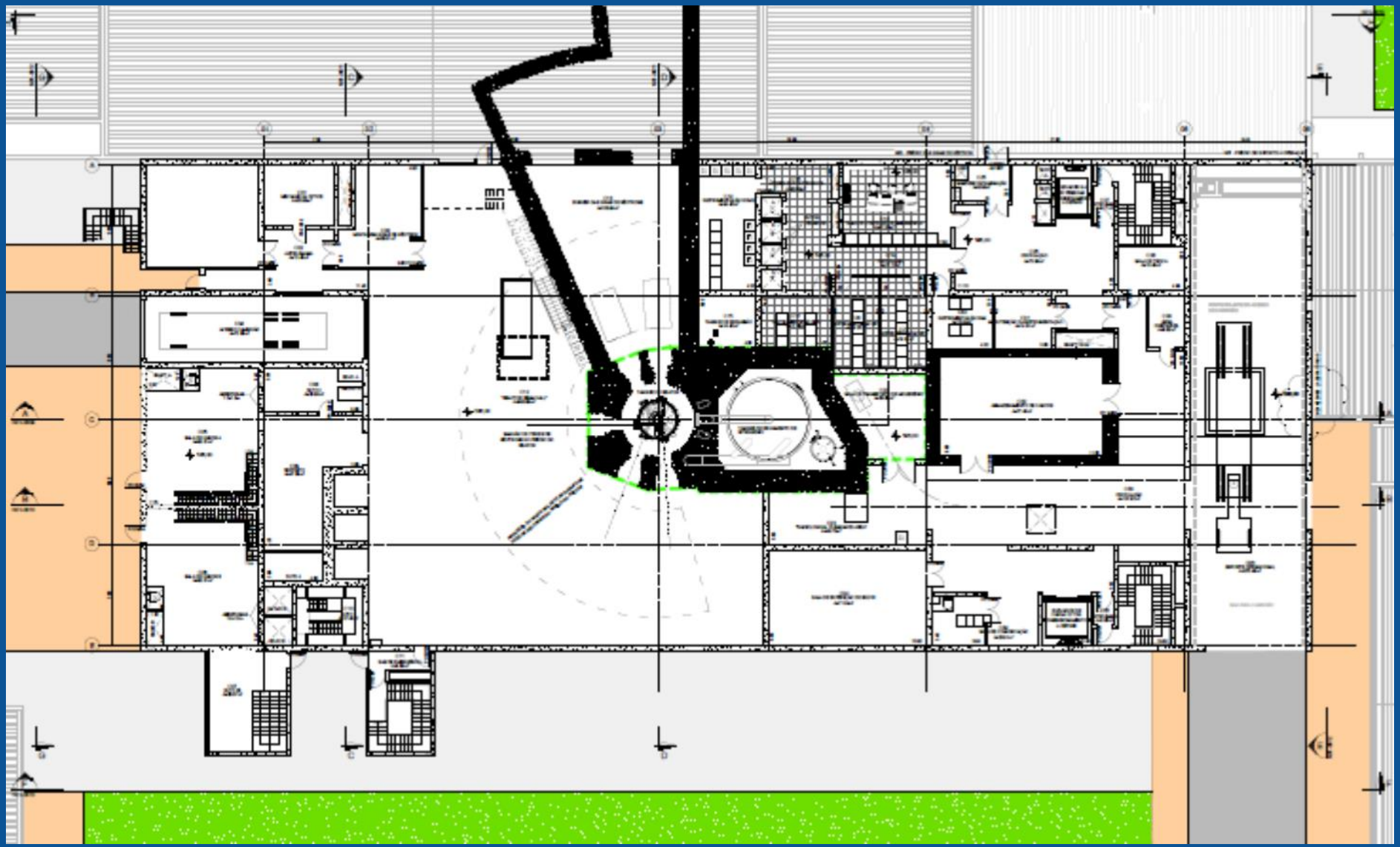
+0,00 m level



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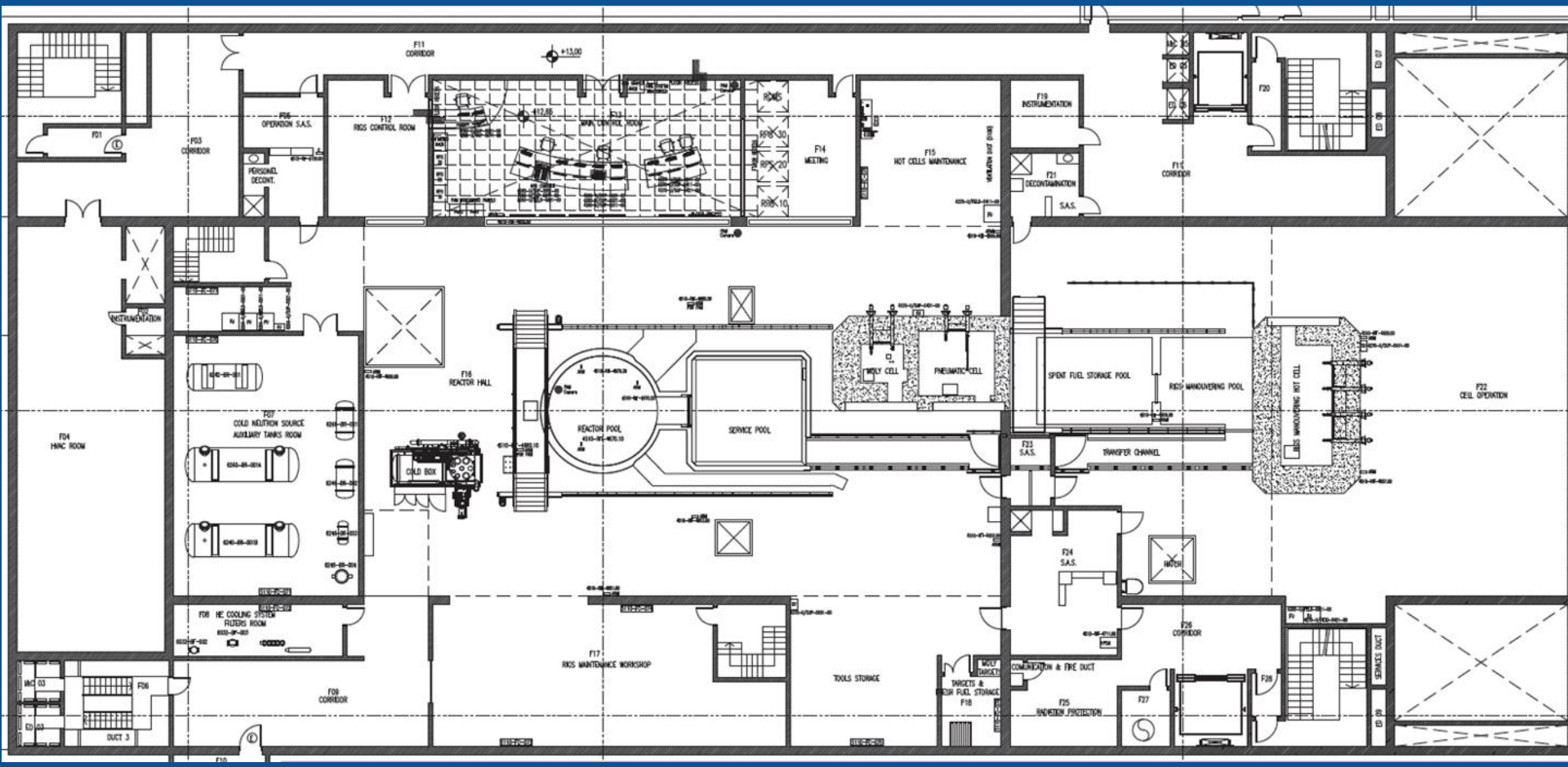
+ 13.00 m level



RMB PROJECT HIGHLIGHTS

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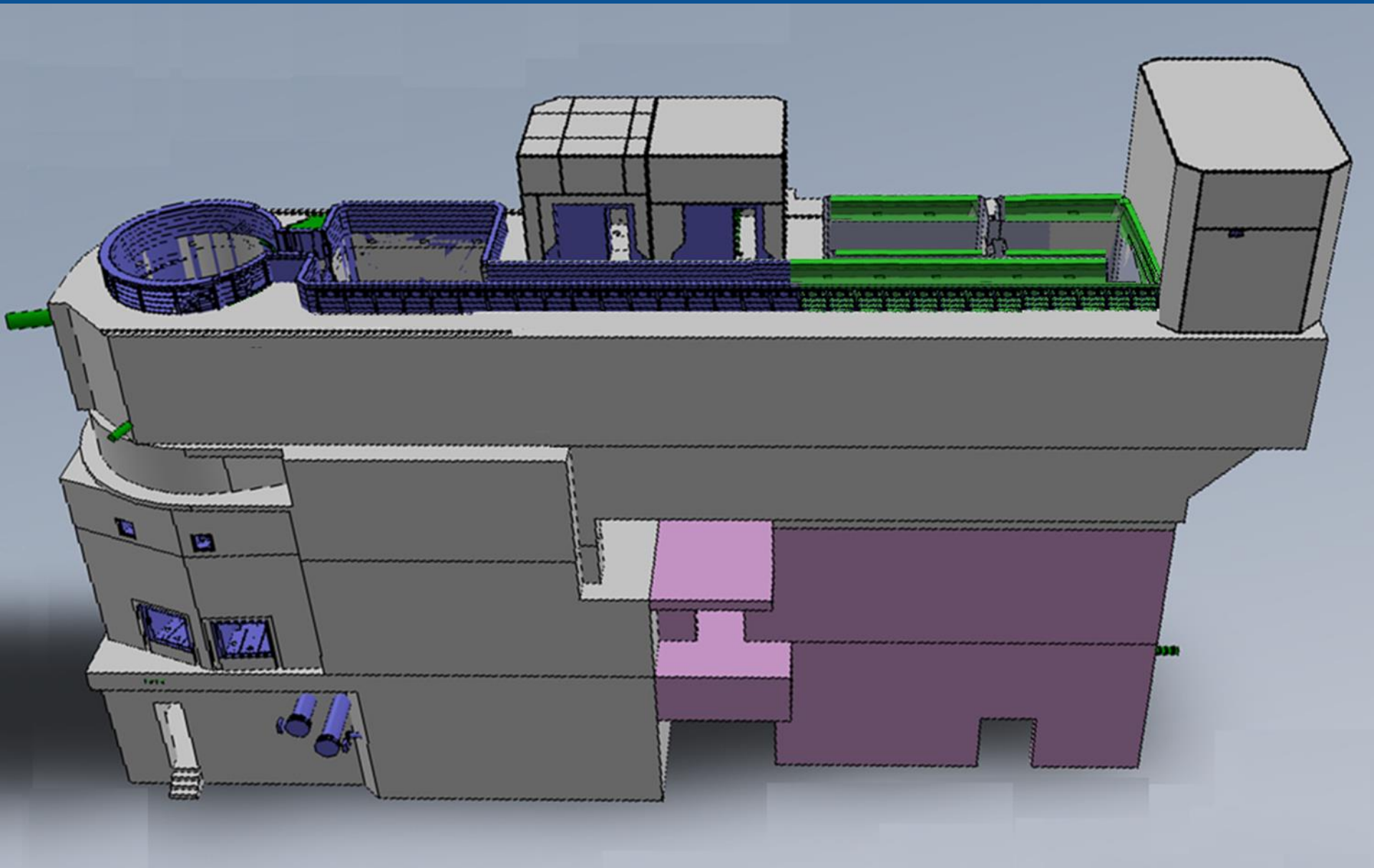
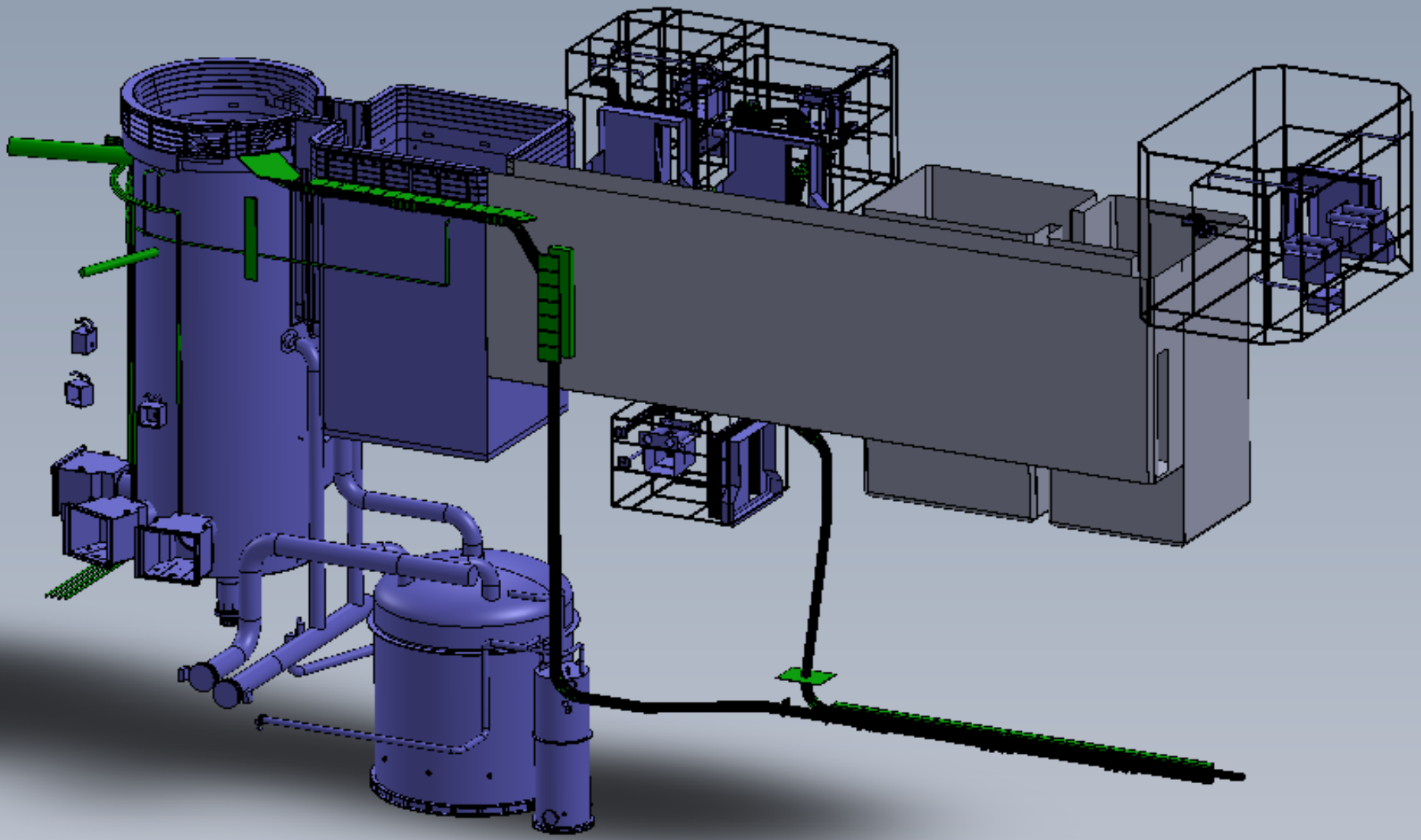


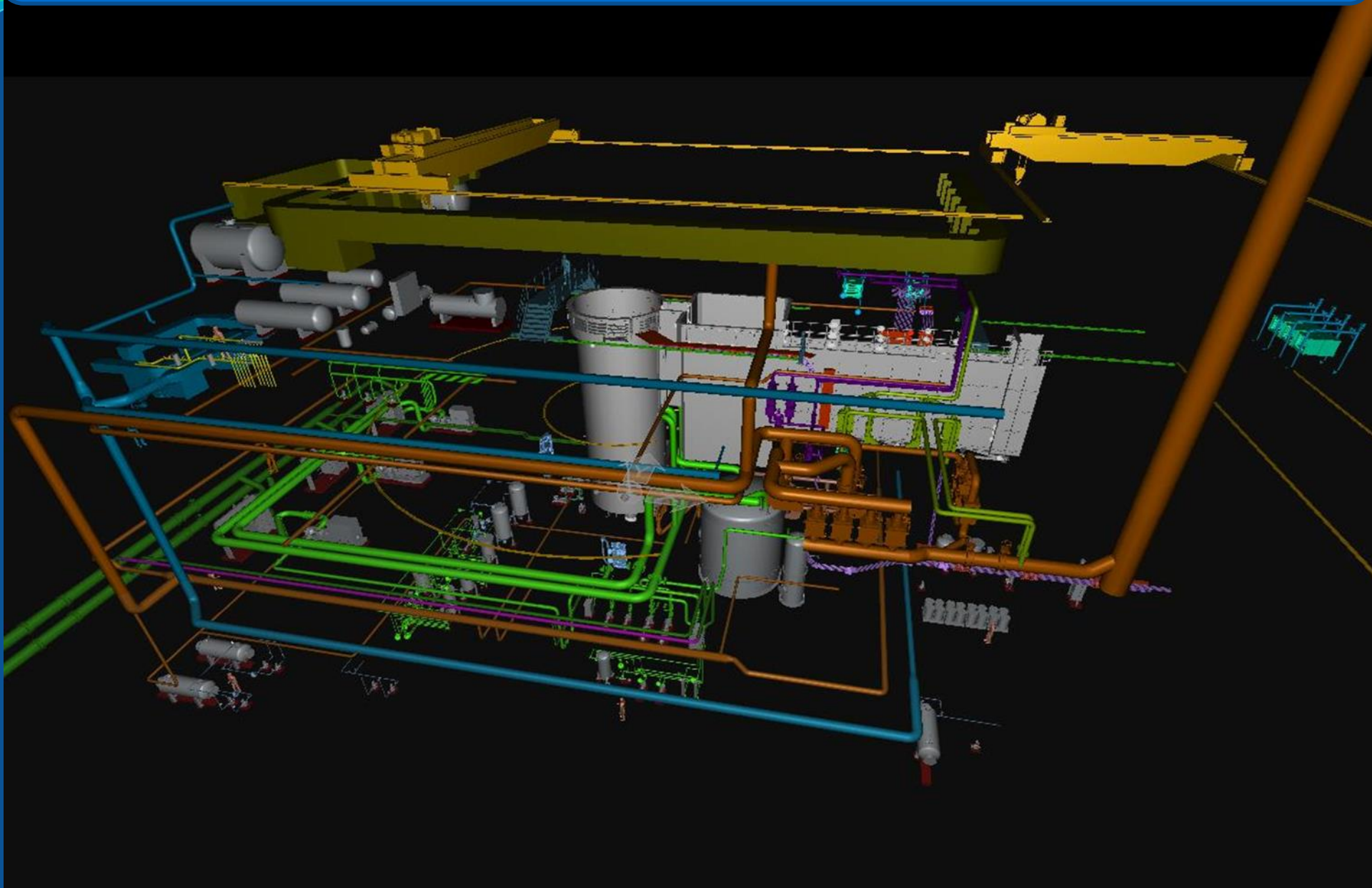
RMB PROJECT HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação



RMB PROJECT HIGHLIGHTS

Ministério da Ciência, Tecnologia e Inovação



RMB PROJECT HIGHLIGHTS

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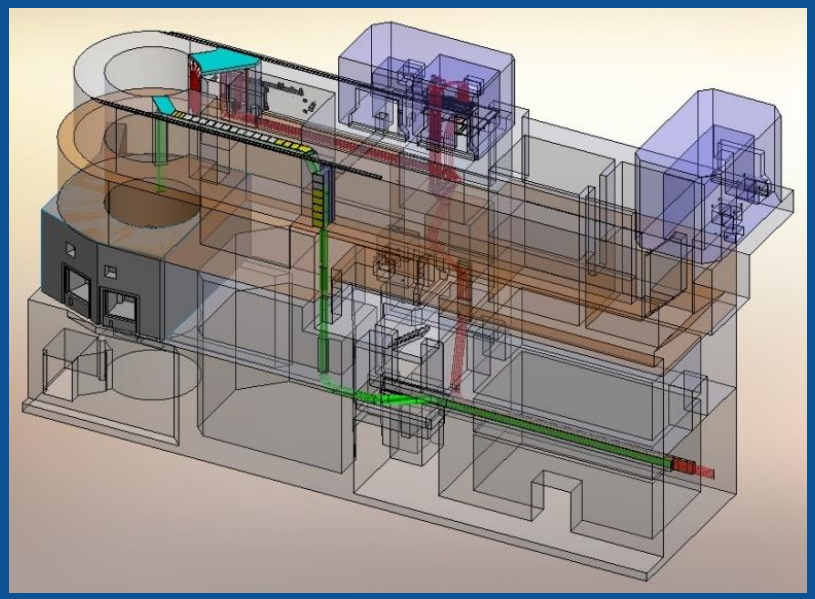
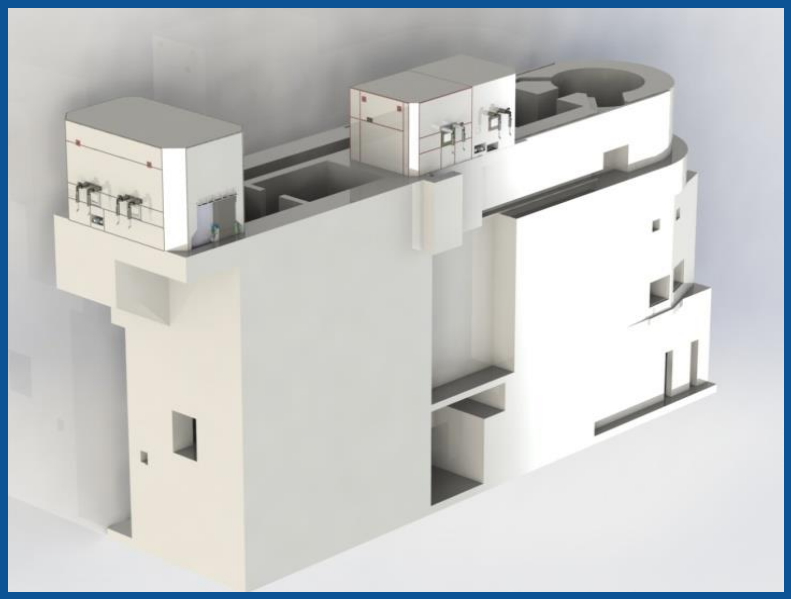
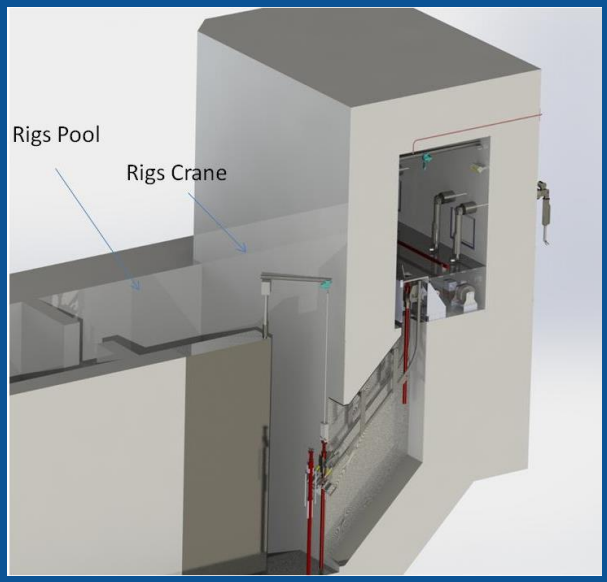




Hot Cells



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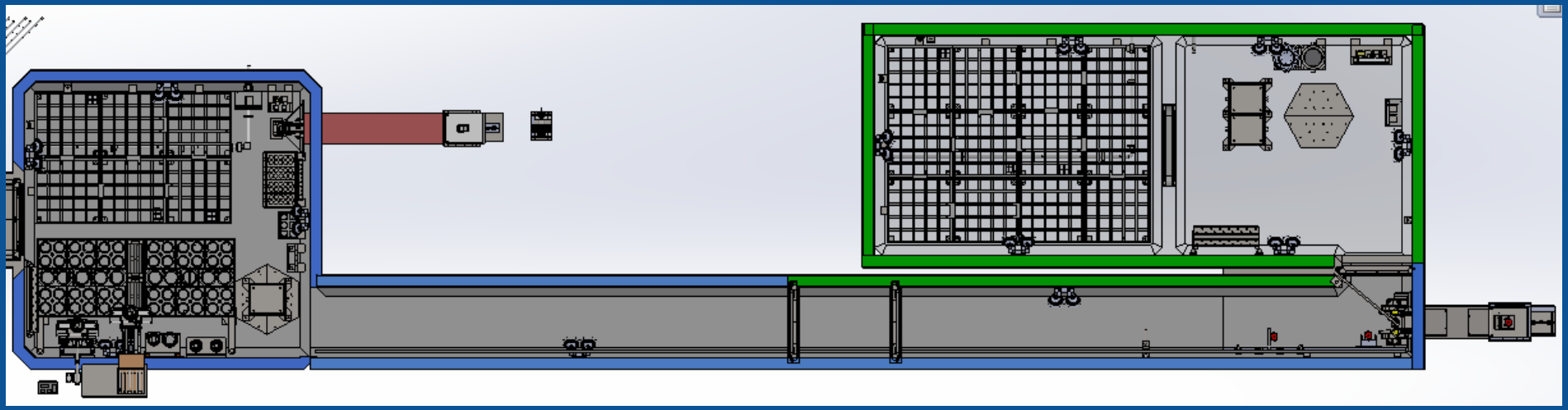
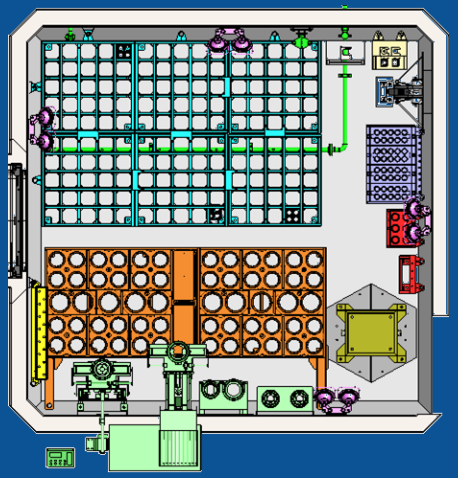
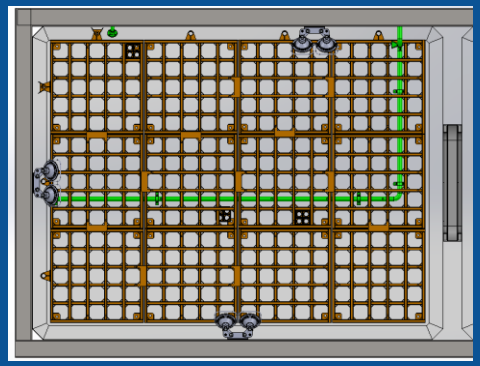
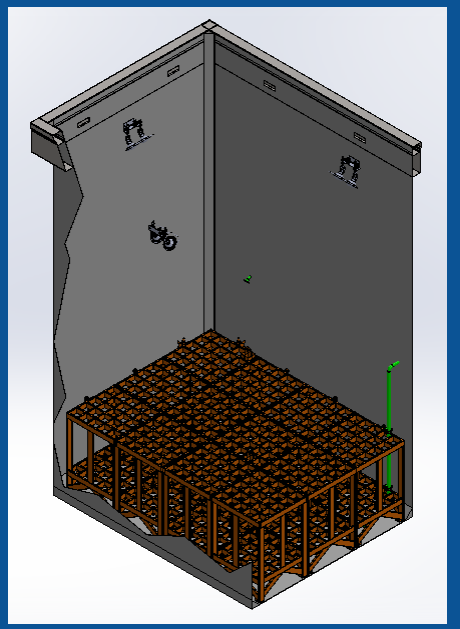
Pools









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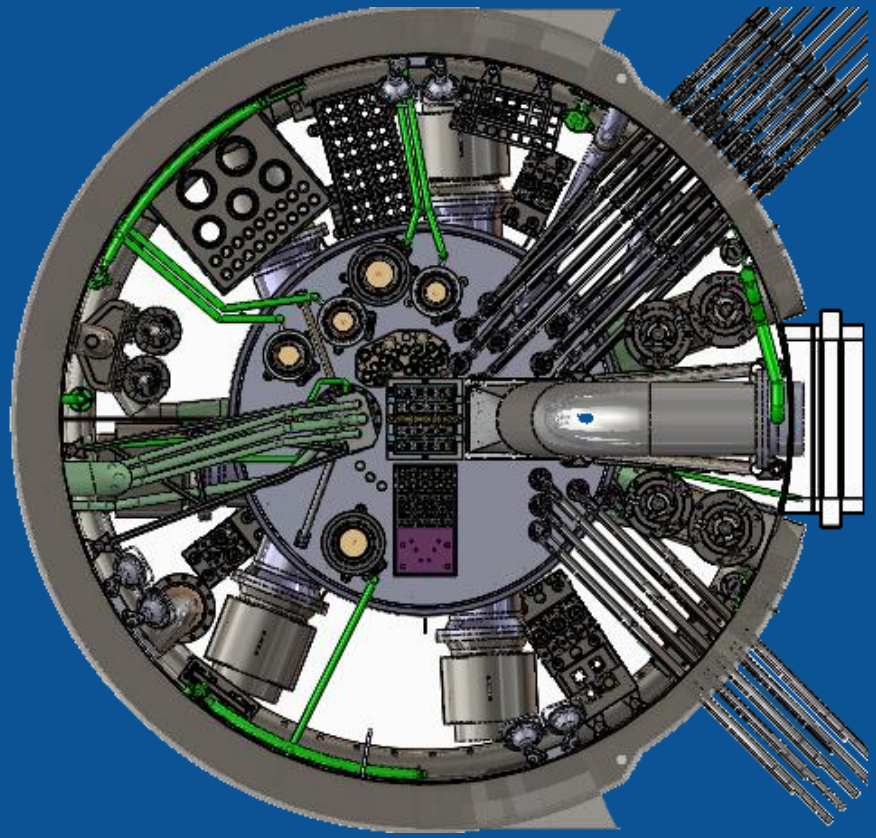
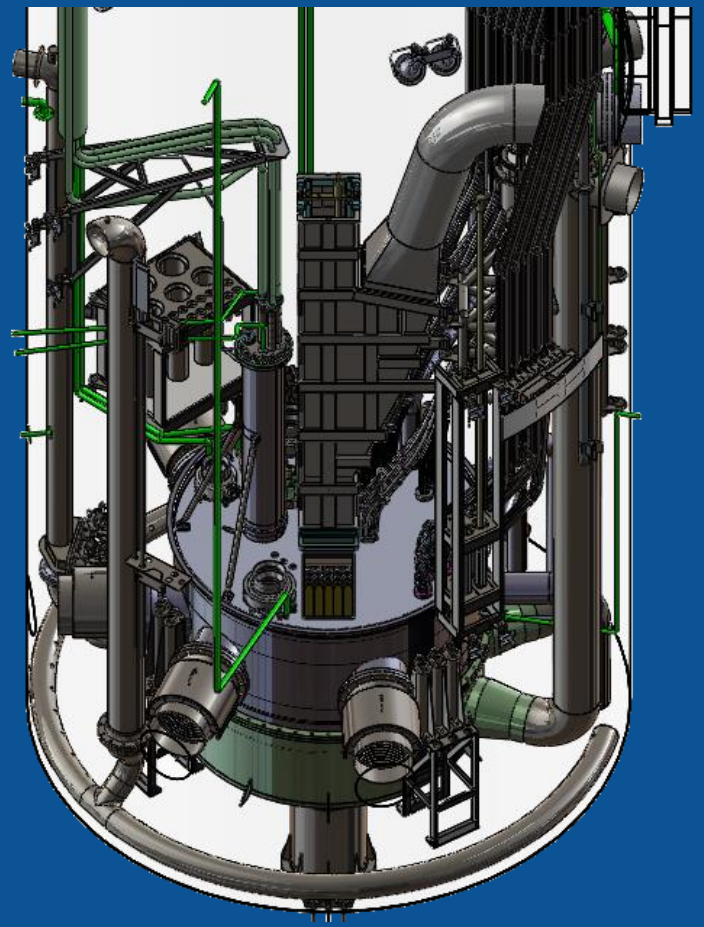
Reactor Layout





RMB PROJECT HIGHLIGHTS

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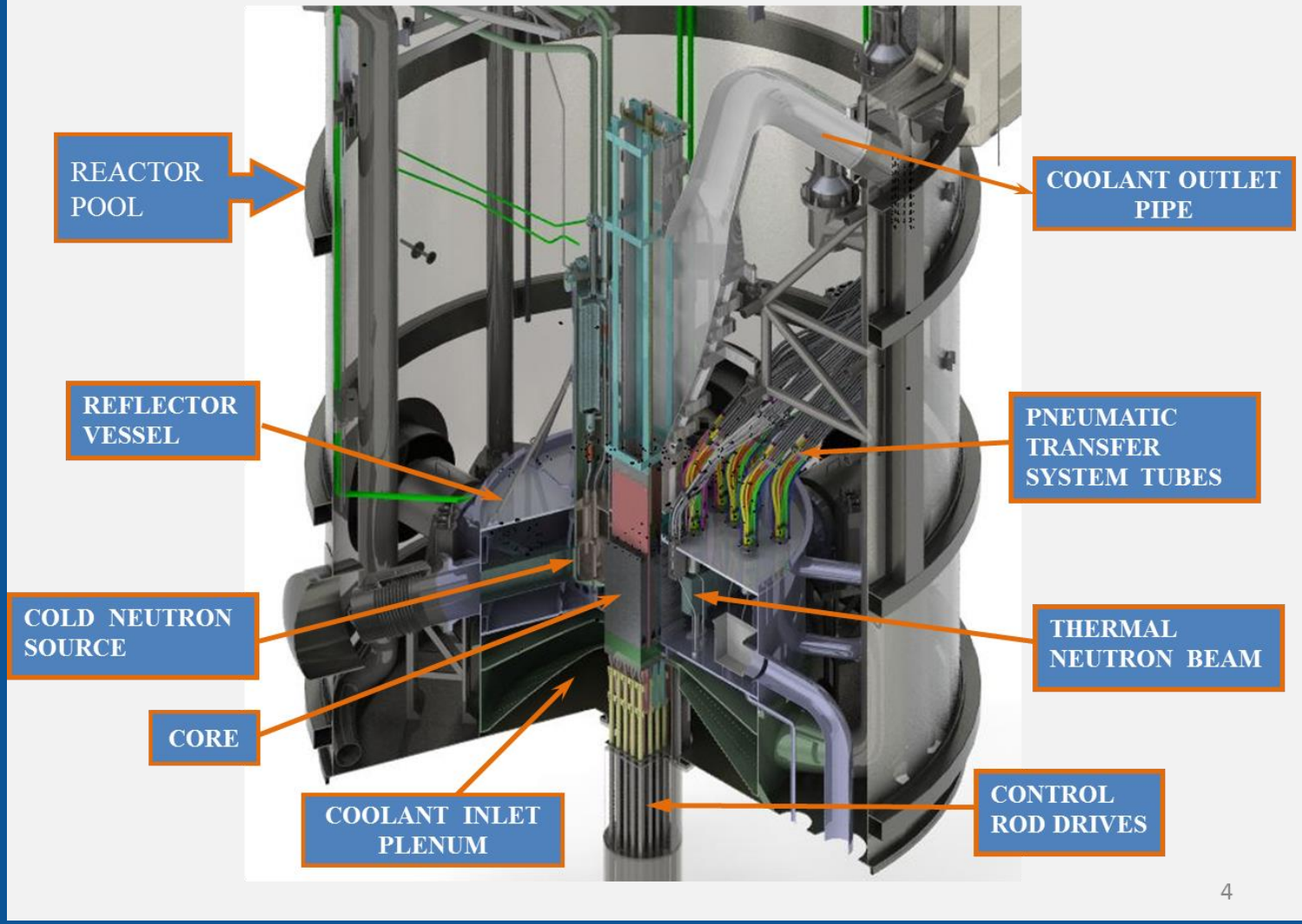
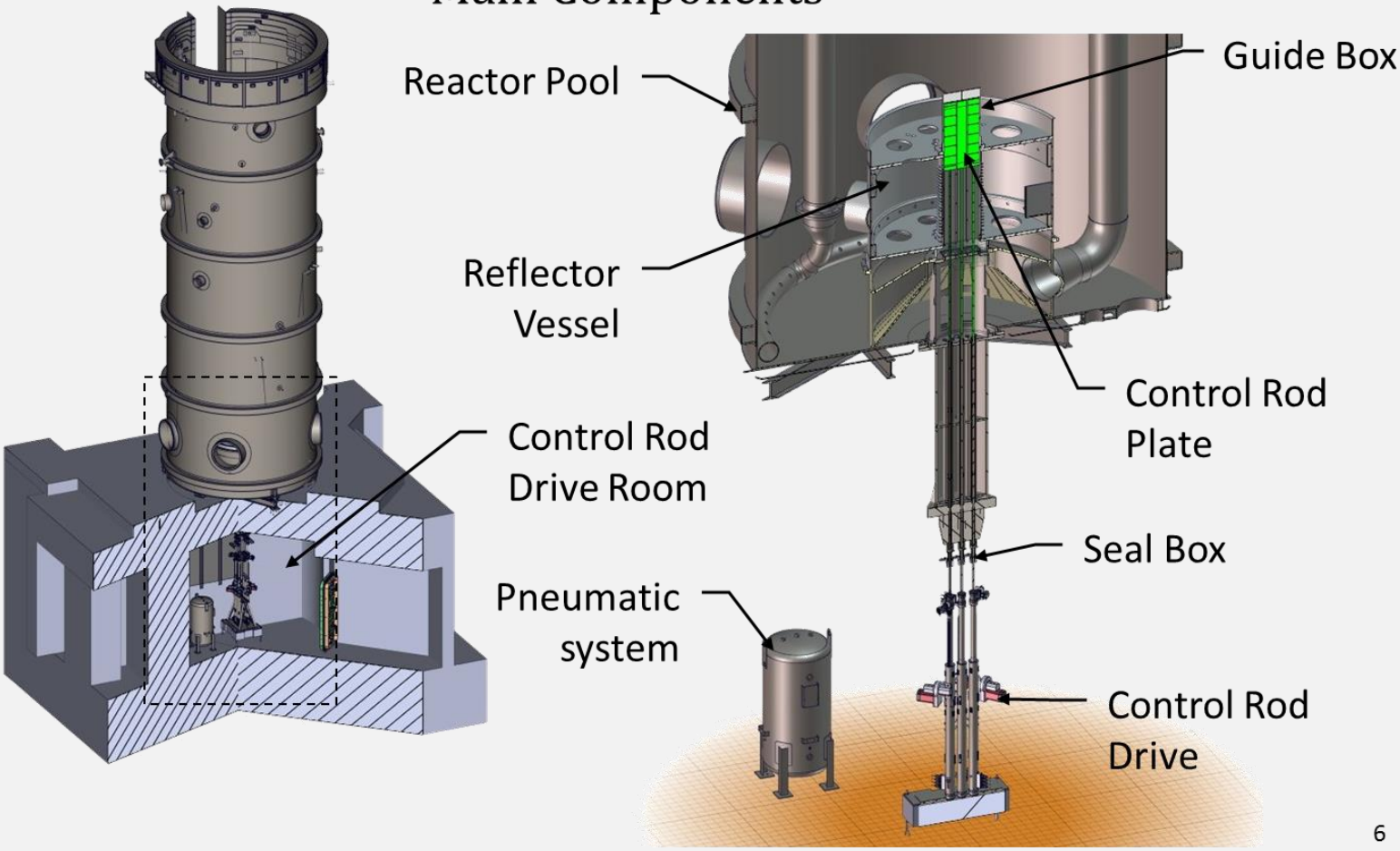
Nuclear Design



Reactivity Control and First Shutdown System

Main Components



RMB PROJECT HIGHLIGHTS

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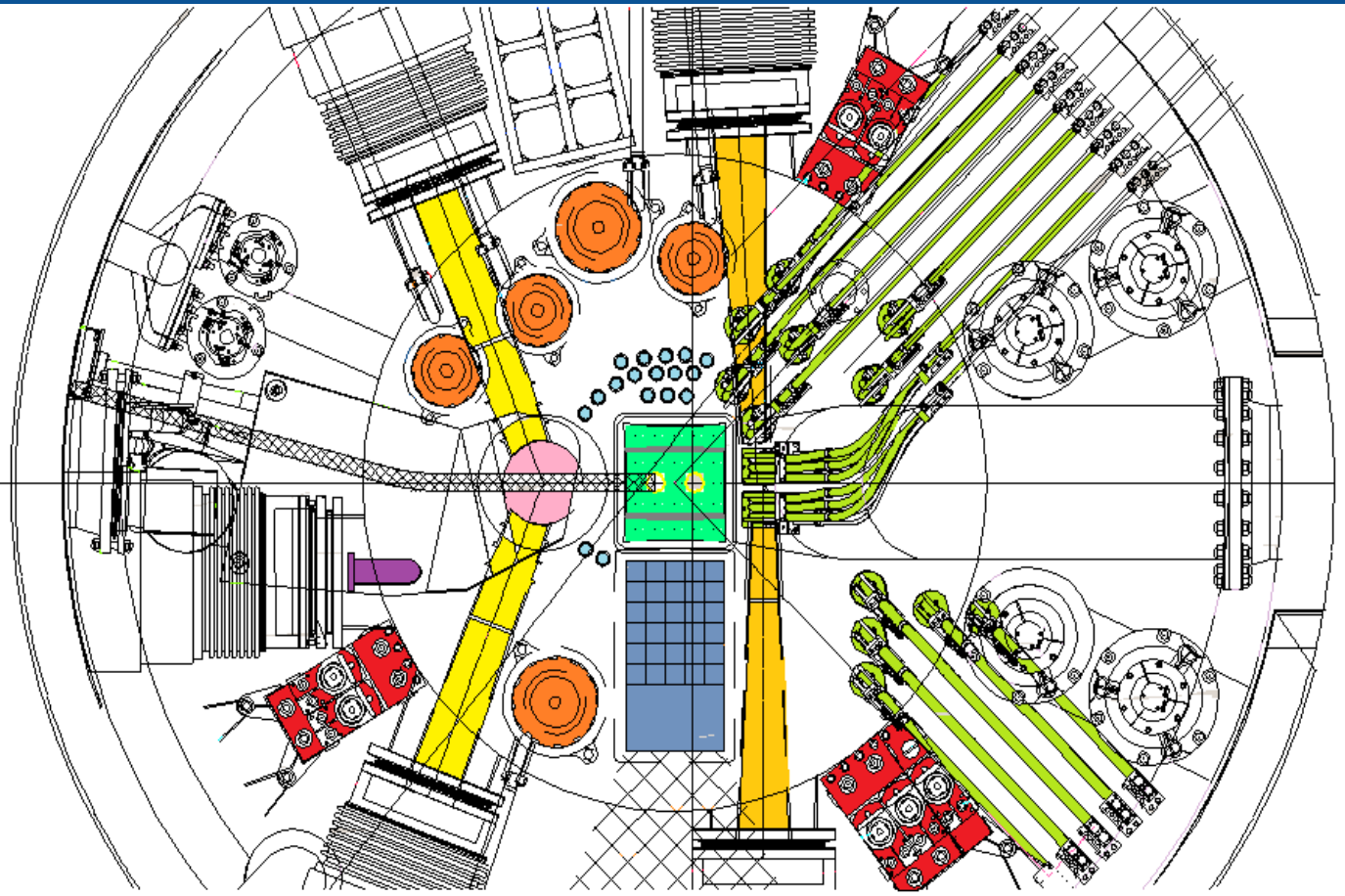
Reactor layout



- Pneumatics
- Silicon
- Cold Neutron Source
- Out of Core Irradiation Facilities
- Cold Neutron Beams
- Thermal Neutron Beams
- Neutrongraphy Beam
- Fuel Irradiation Facility
- Neutronic Detectors

RMB PROJECT HIGHLIGHTS

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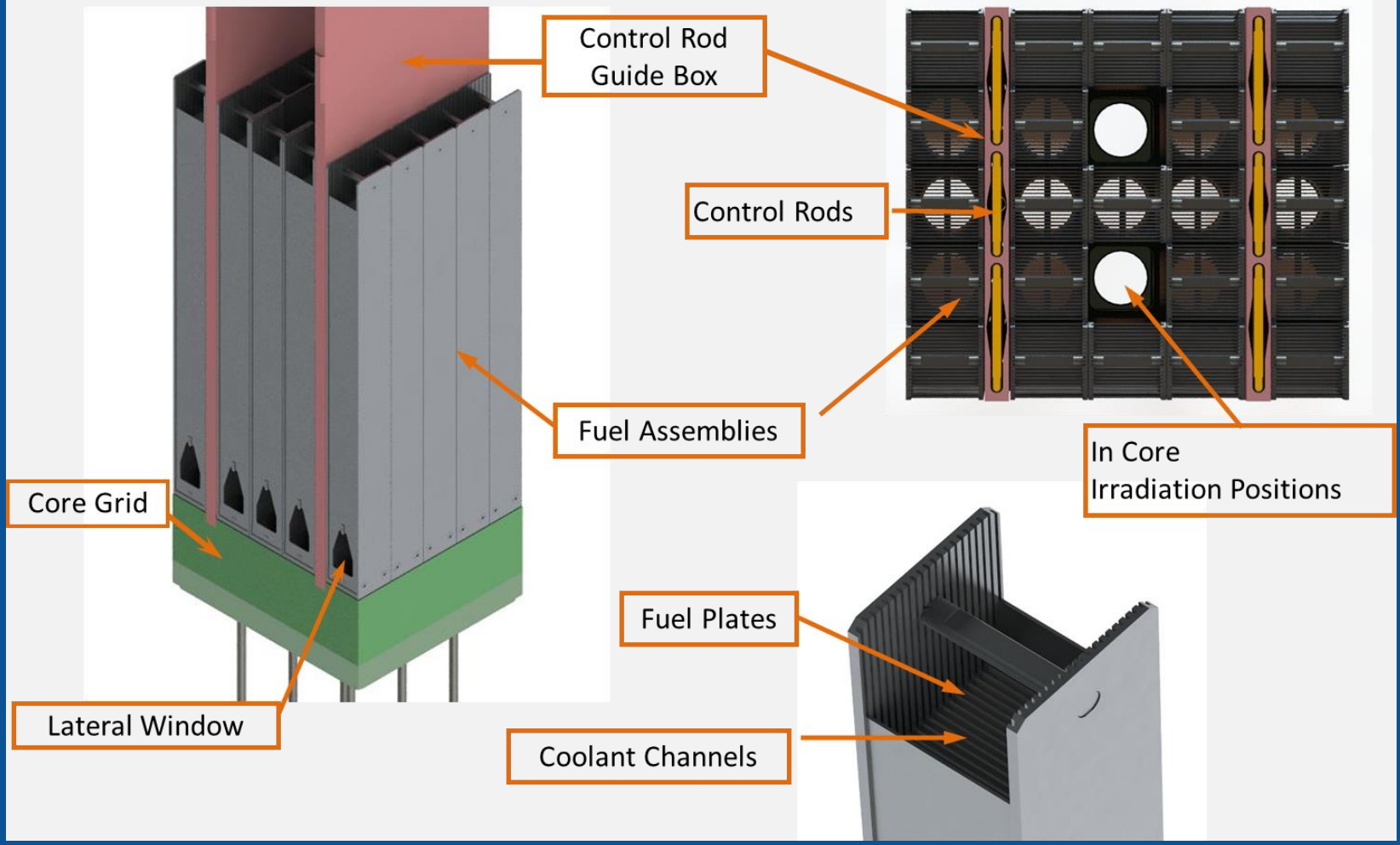
Core and Fuel Assemblies



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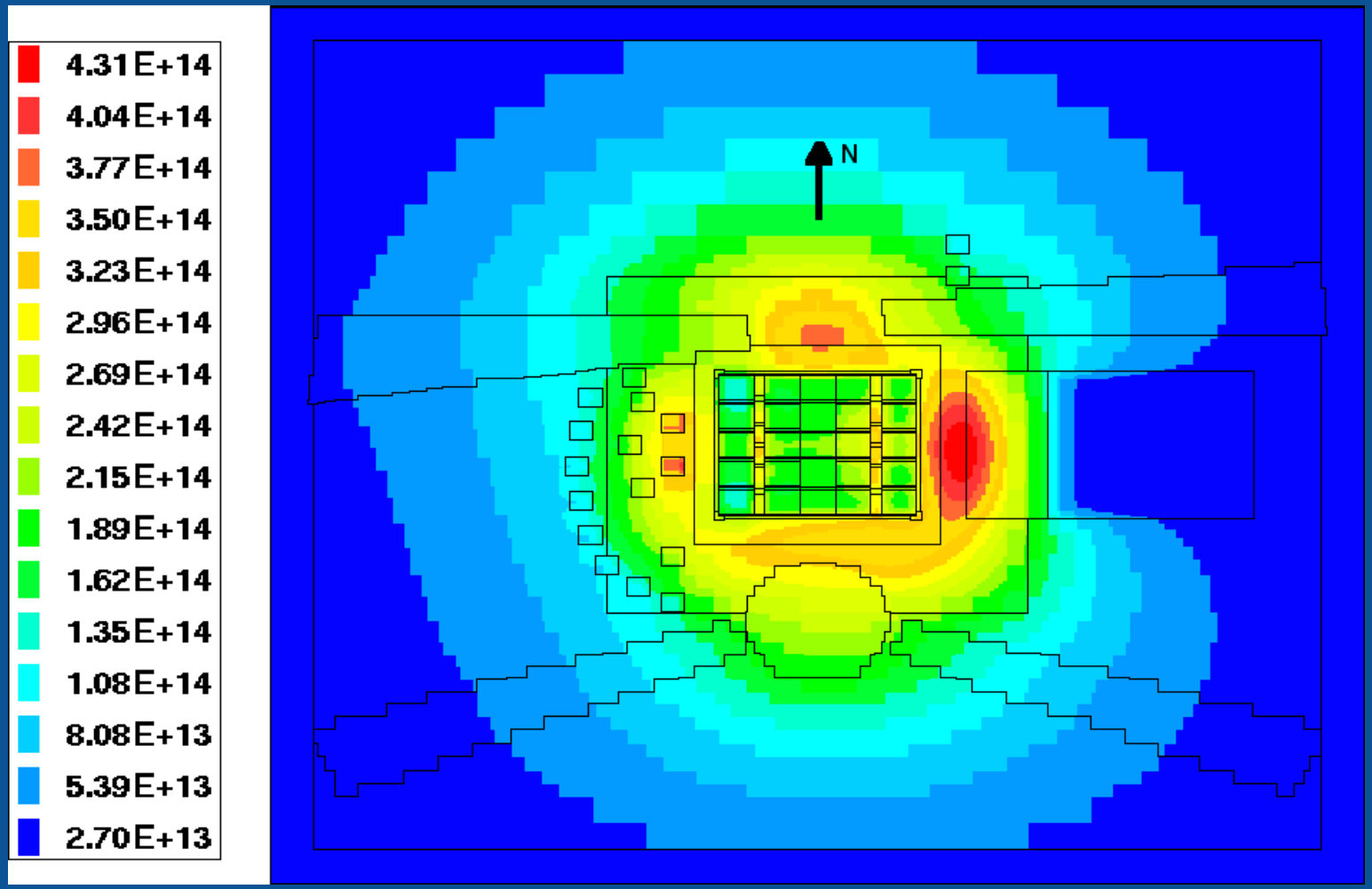
Thermal flux [n/cm^{2}s]En <0.625 eV - Midline of active length



RMB PROJECT HIGHLIGHTS

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Reflector Vessel
Irradiation Facilities

- Bulk Irradiation Positions (3000 Ci end of irrad.)

Quantity	17 + 3
Main Dimension	Ø 60mm

- Pneumatic Irradiation Positions

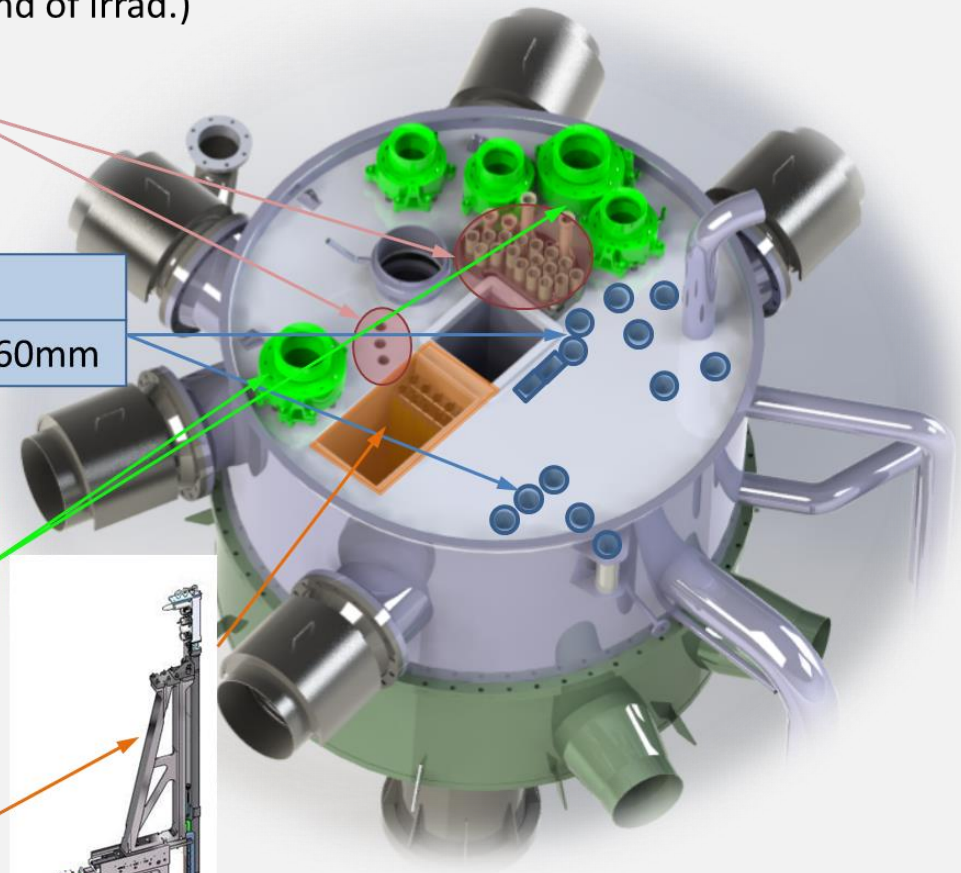
Quantity	12	2
Dimension	Ø 110mm	110mm x 260mm

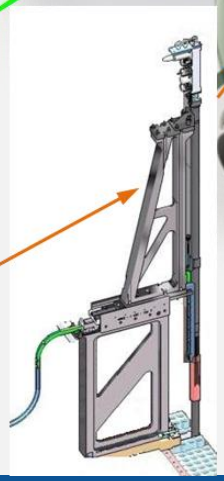
- NTD Irradiation Positions

Quantity	3	2
Main Dimension	Ø 6”	Ø 8”

- Loop Irradiation Area

Quantity	1
Main Dimension	410mm x 750mm





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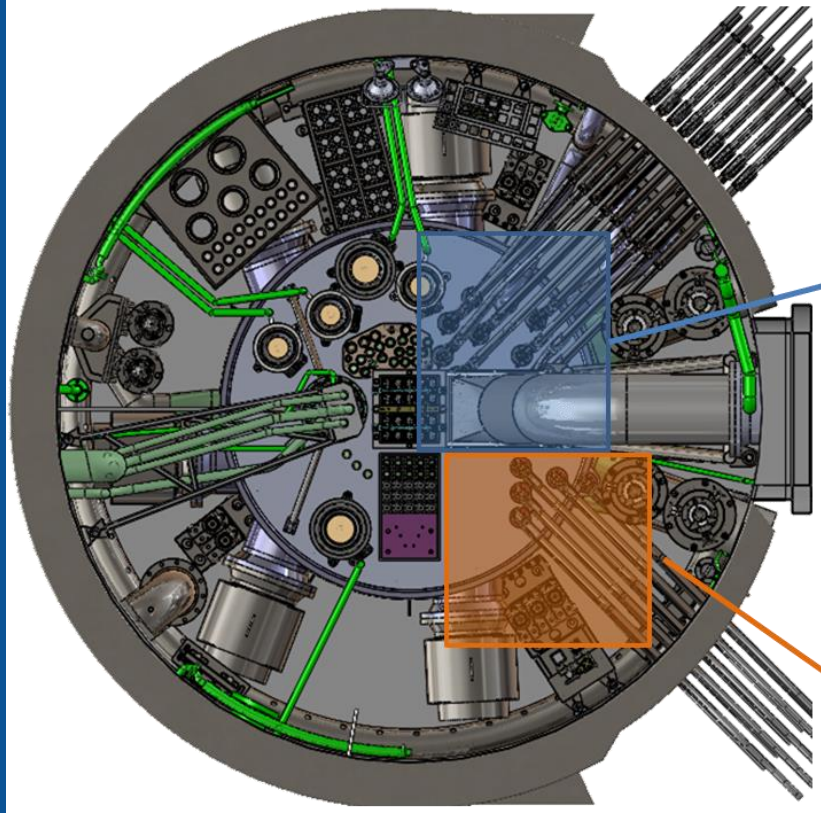
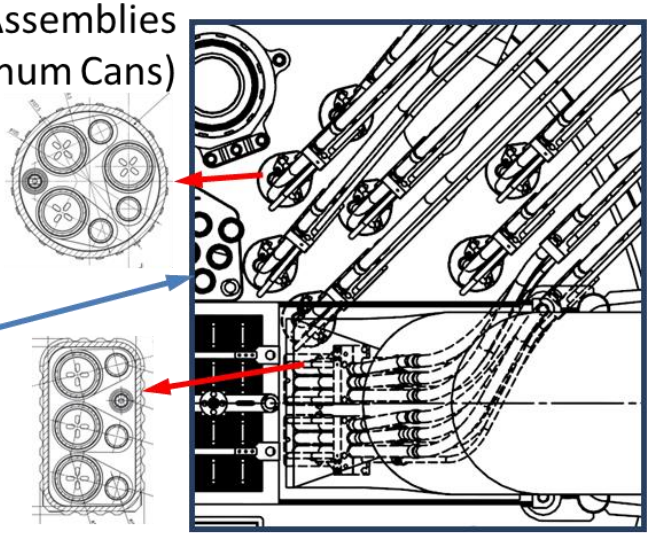
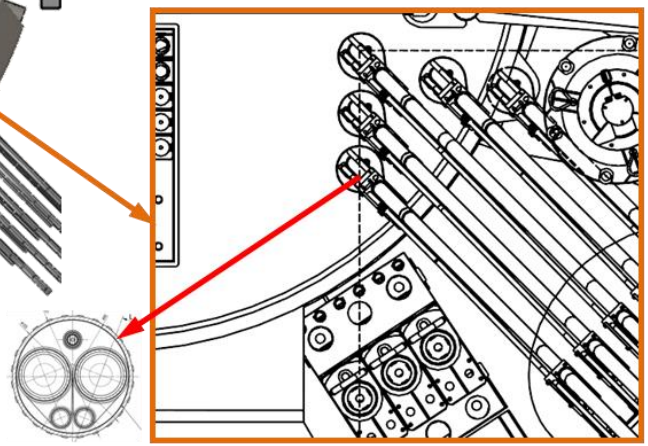
Pneumatic Irradiation Facilities



9 In Pile Assemblies (Aluminum Cans)





5 In Pile Assemblies (Short time irradiation - Plastic Cans)

RMB PROJECT HIGHLIGHTS

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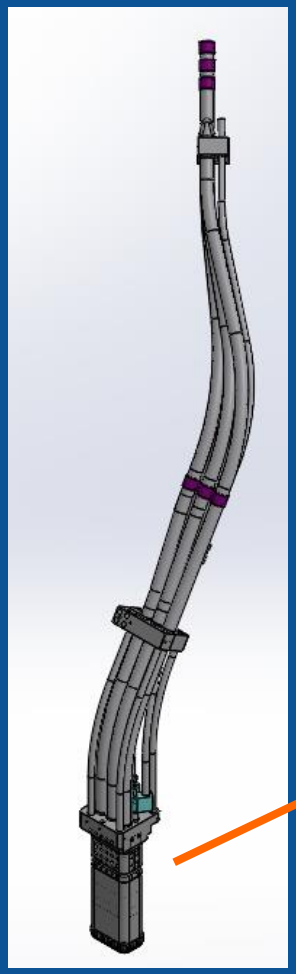
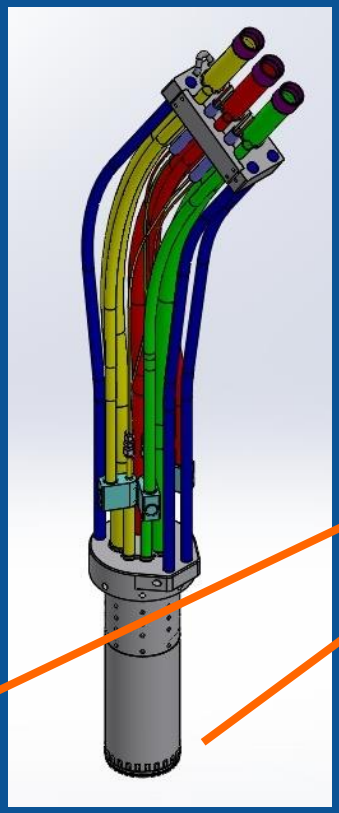
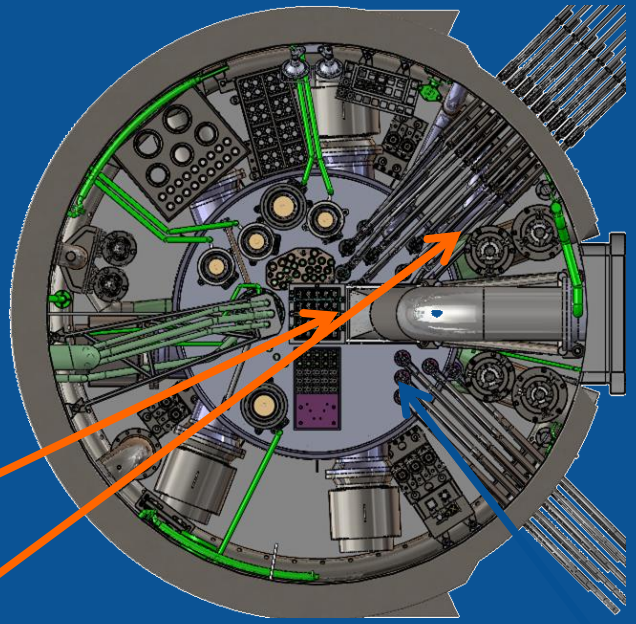
Pneumatic Irradiation Facilities

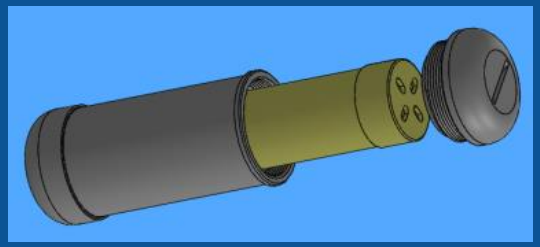


Irradiation Rigs





Irradiation Rigs



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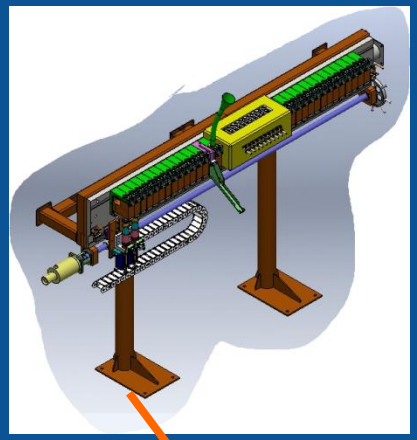
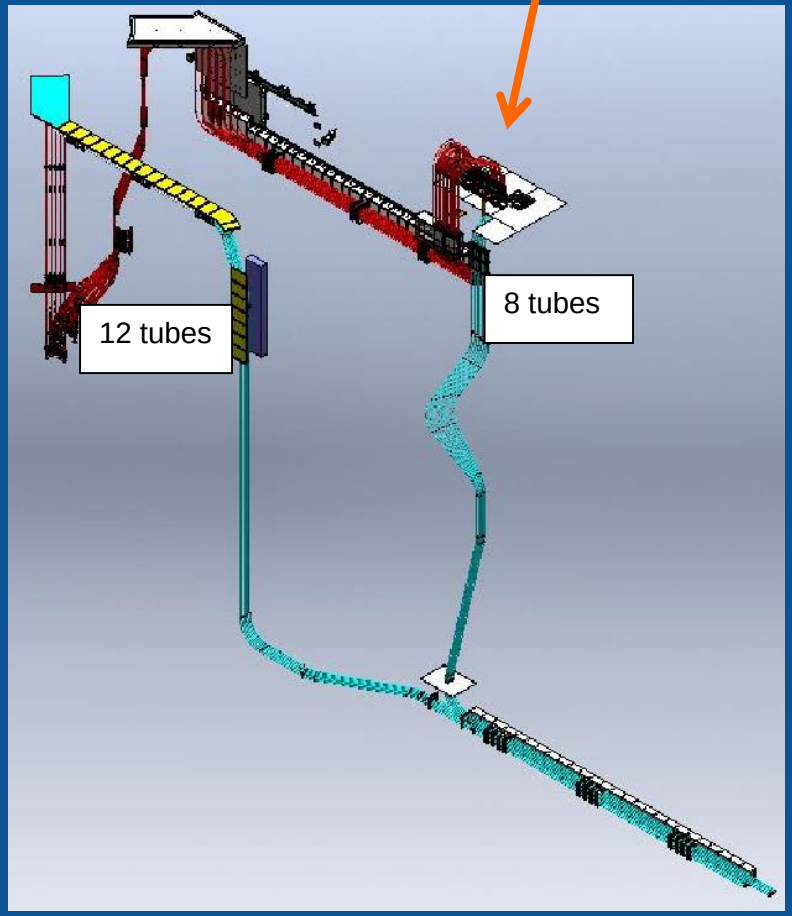
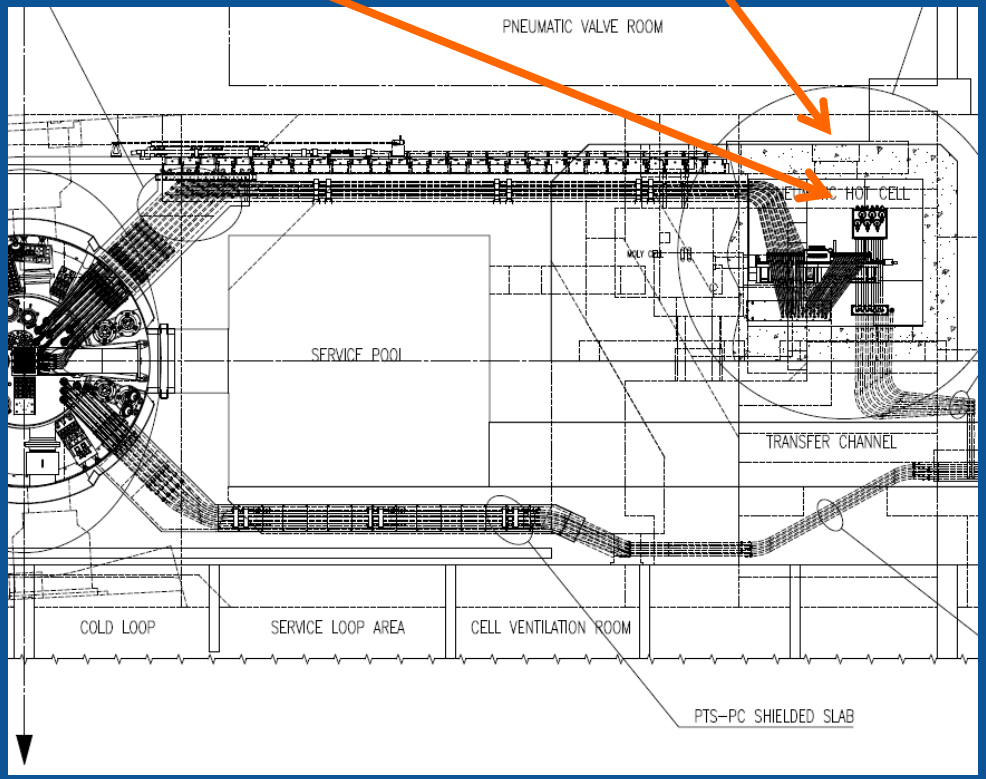
Pneumatic Irradiation Facilities

Pneumatic Hot Cell

Terminal station







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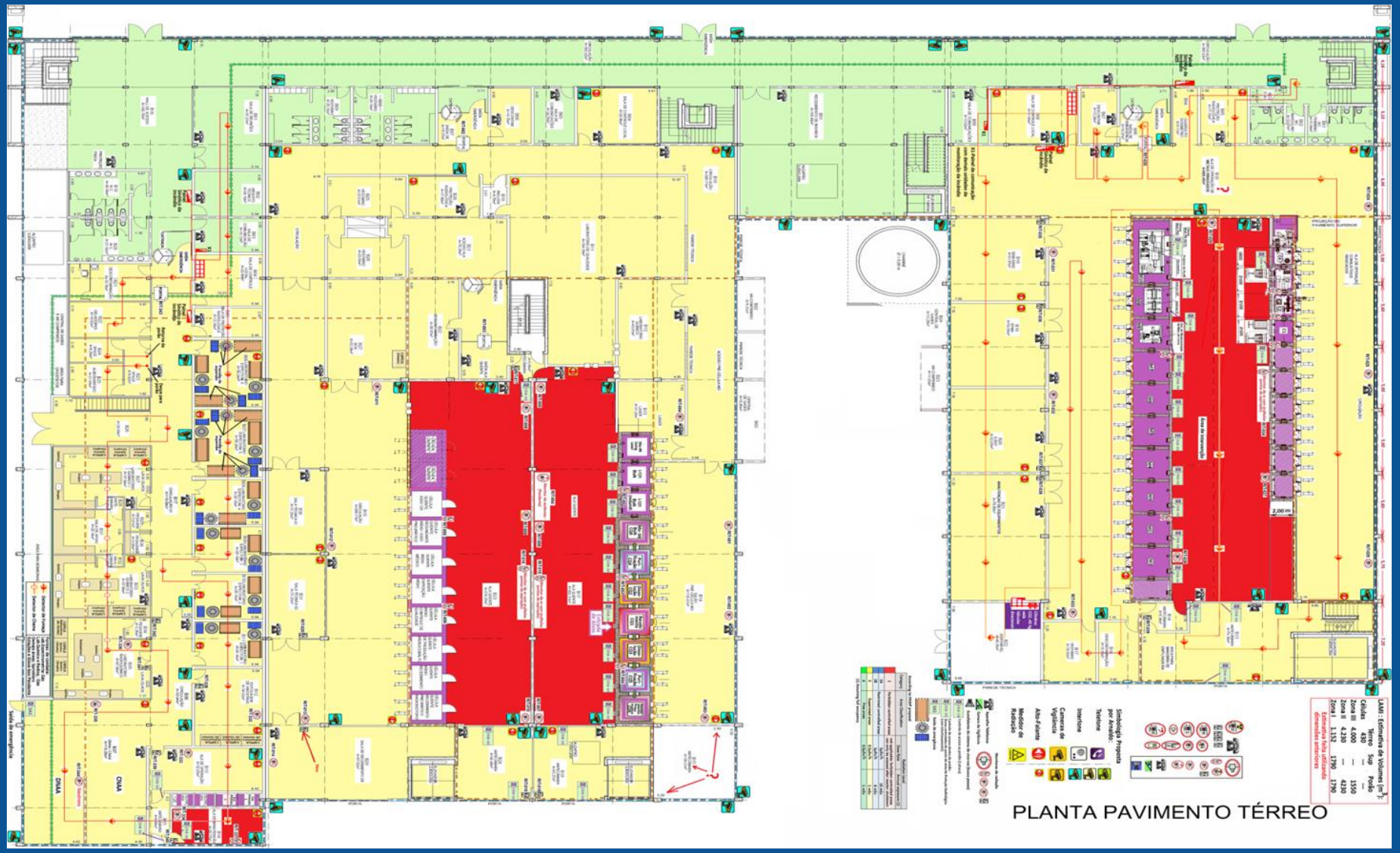
Laboratories



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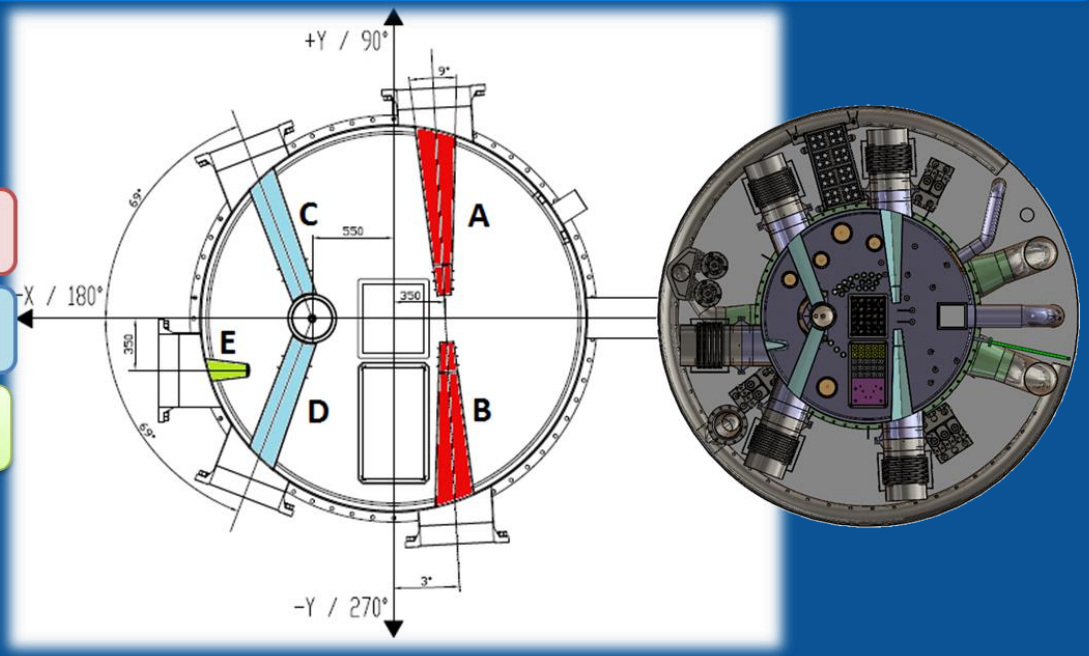
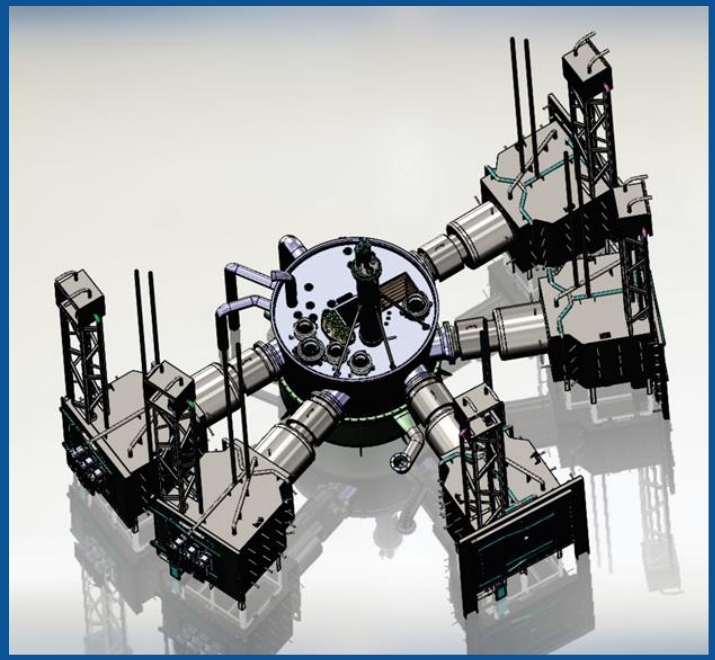
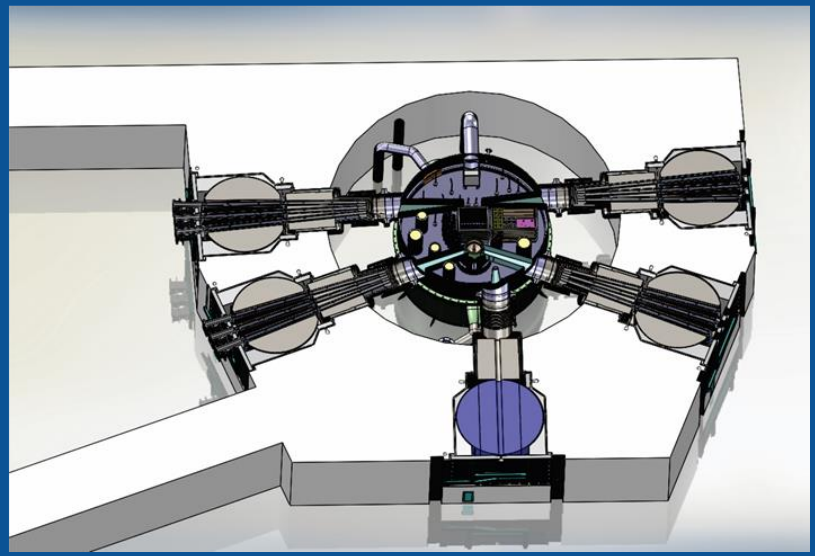
Neutron Beams

- A – B : THERMAL BEAMS
- C – D : COLD BEAMS
- E : NEUTROGRAPHY BEAM







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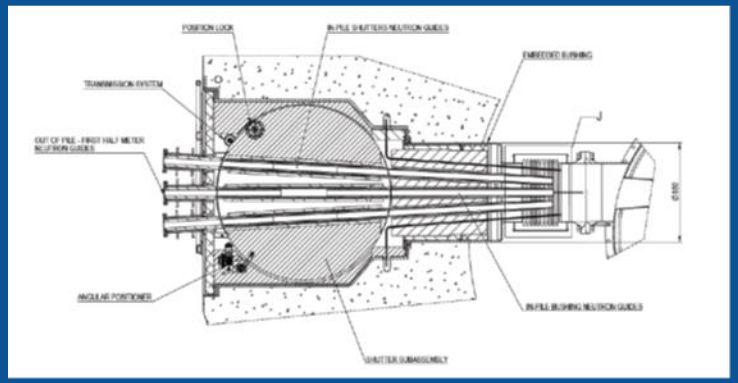
Neutron Beam Shutters



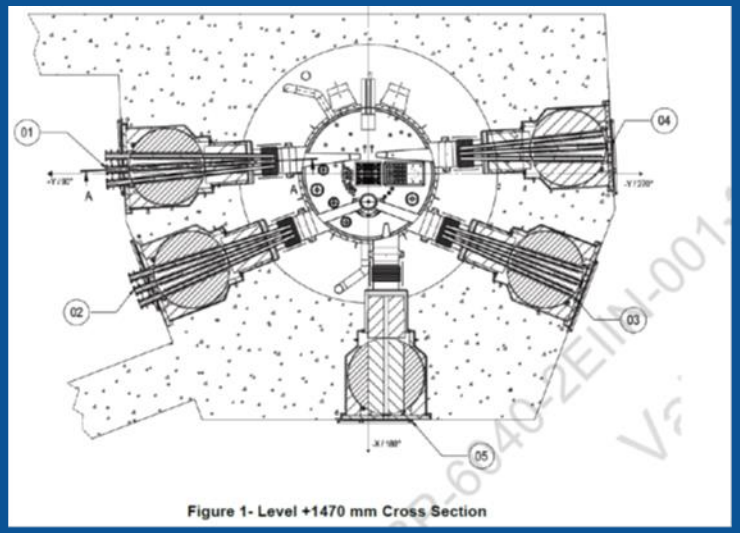
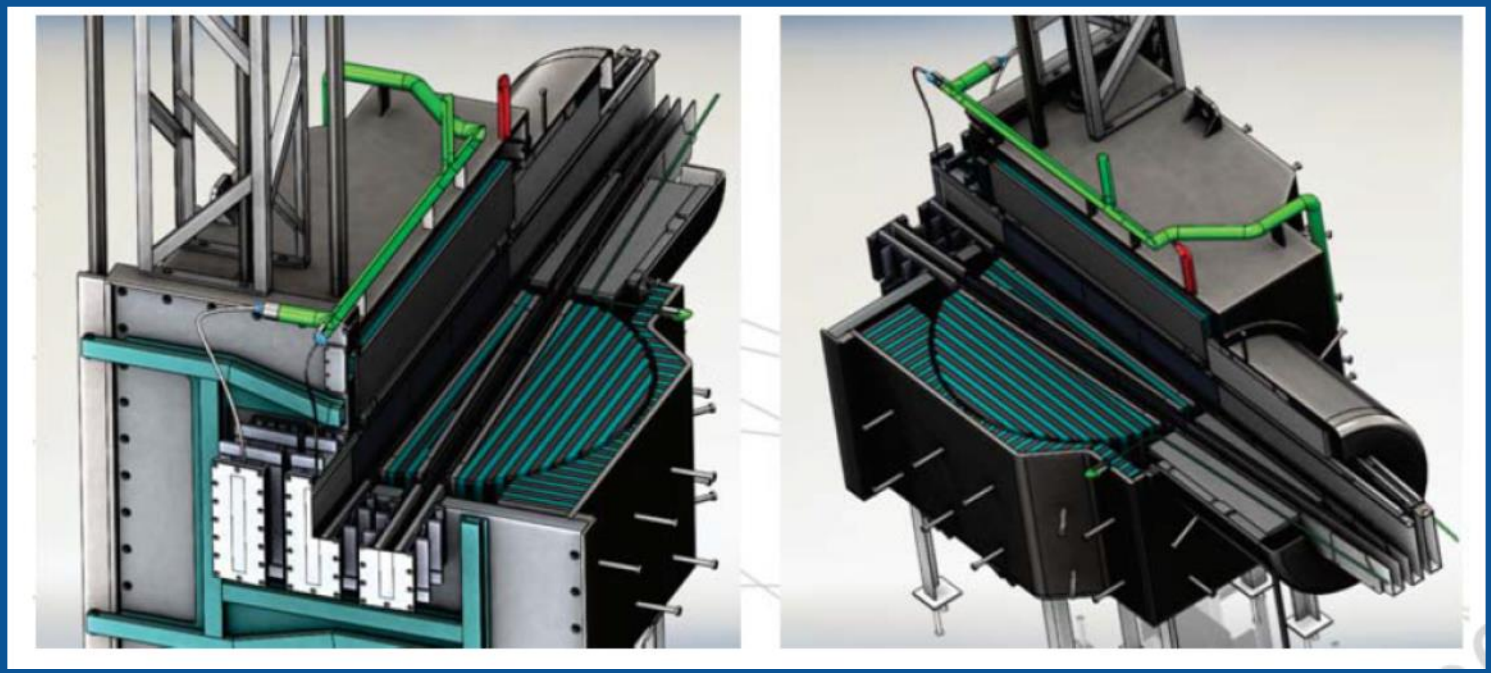


Figure 1- Level +1470 mm Cross Section



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Neutron Beam Shutters

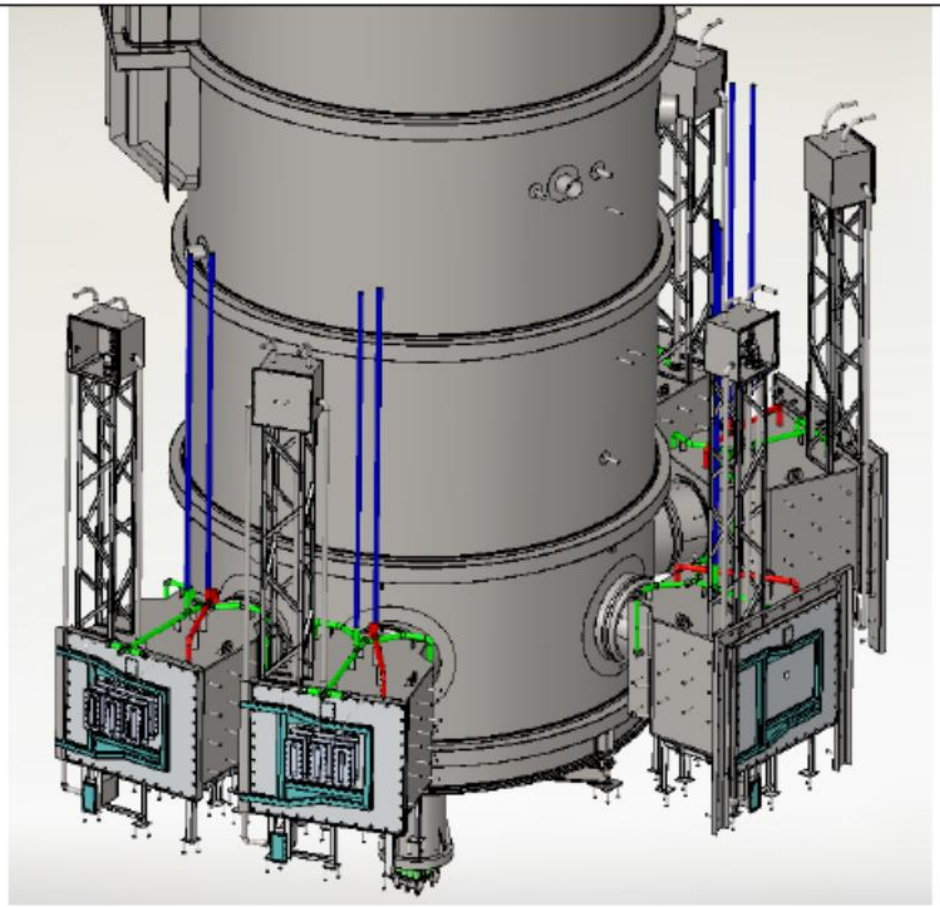

Figure 1-TNB#1,CNB#2,TNB#5 (left to the right)

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Cold Neutron Source

Figure 1: Schematic View of the CNS Thermosiphon

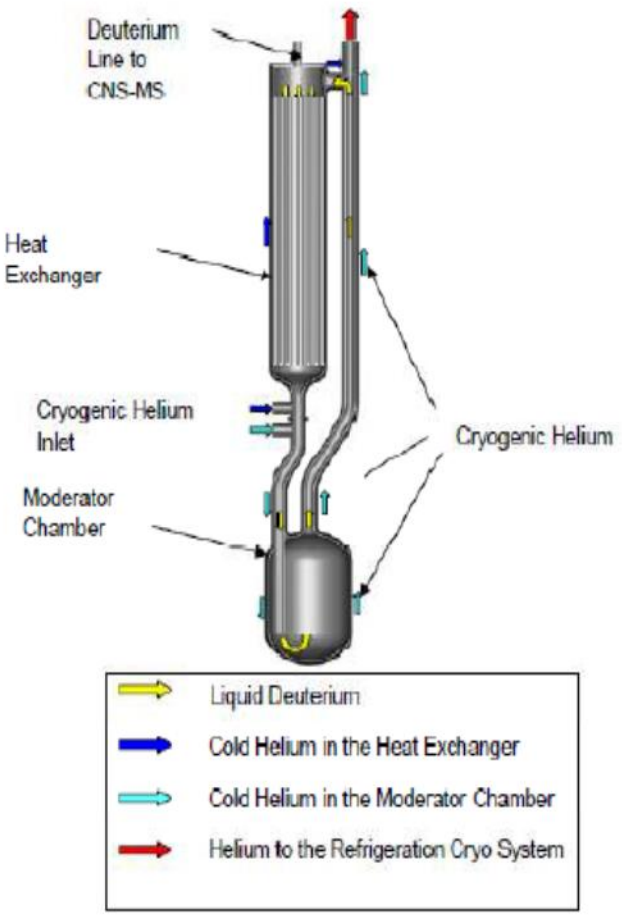


Figure 2: Schematic View of the In-Pile Thimble

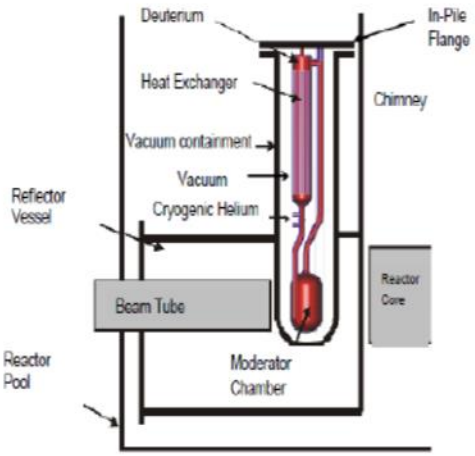
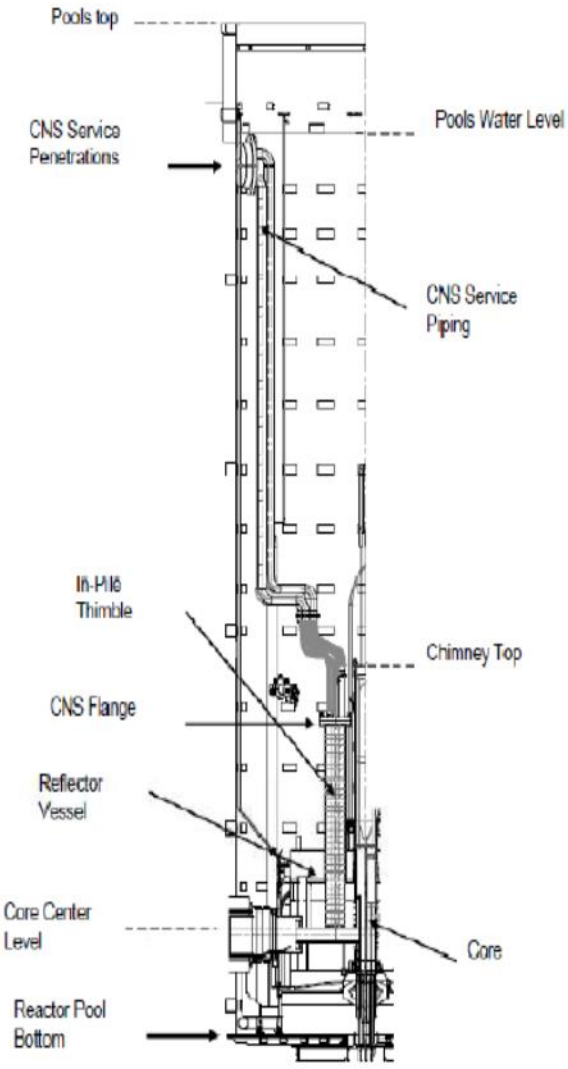


Figure 3: In-Pile Thimble in the Reactor Pool



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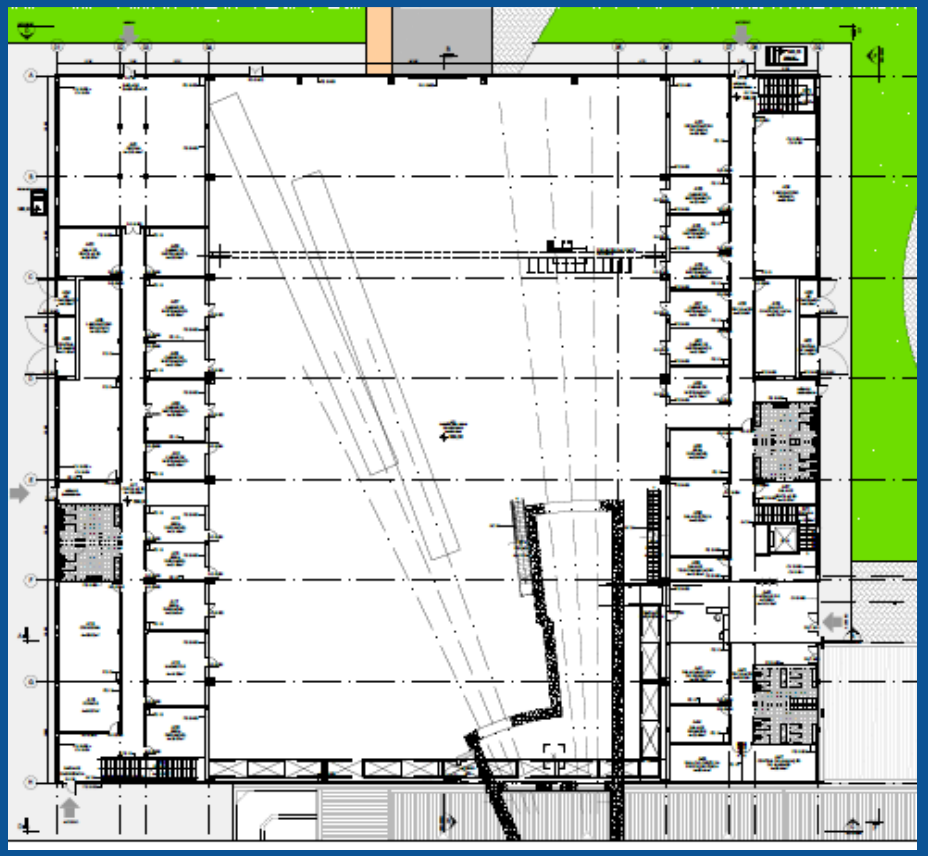
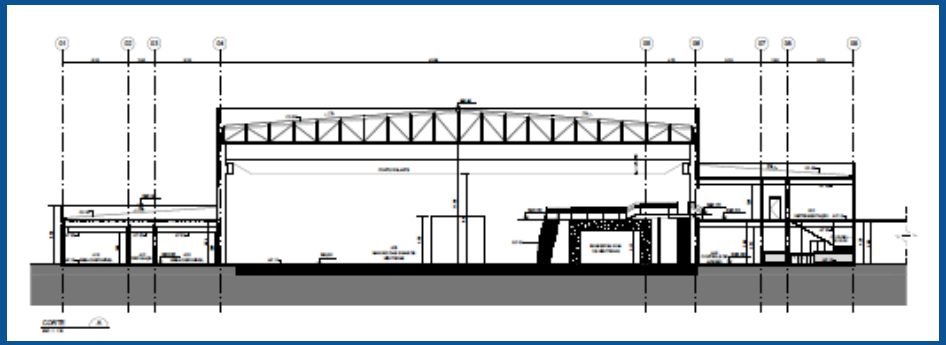
Neutron Guide Building





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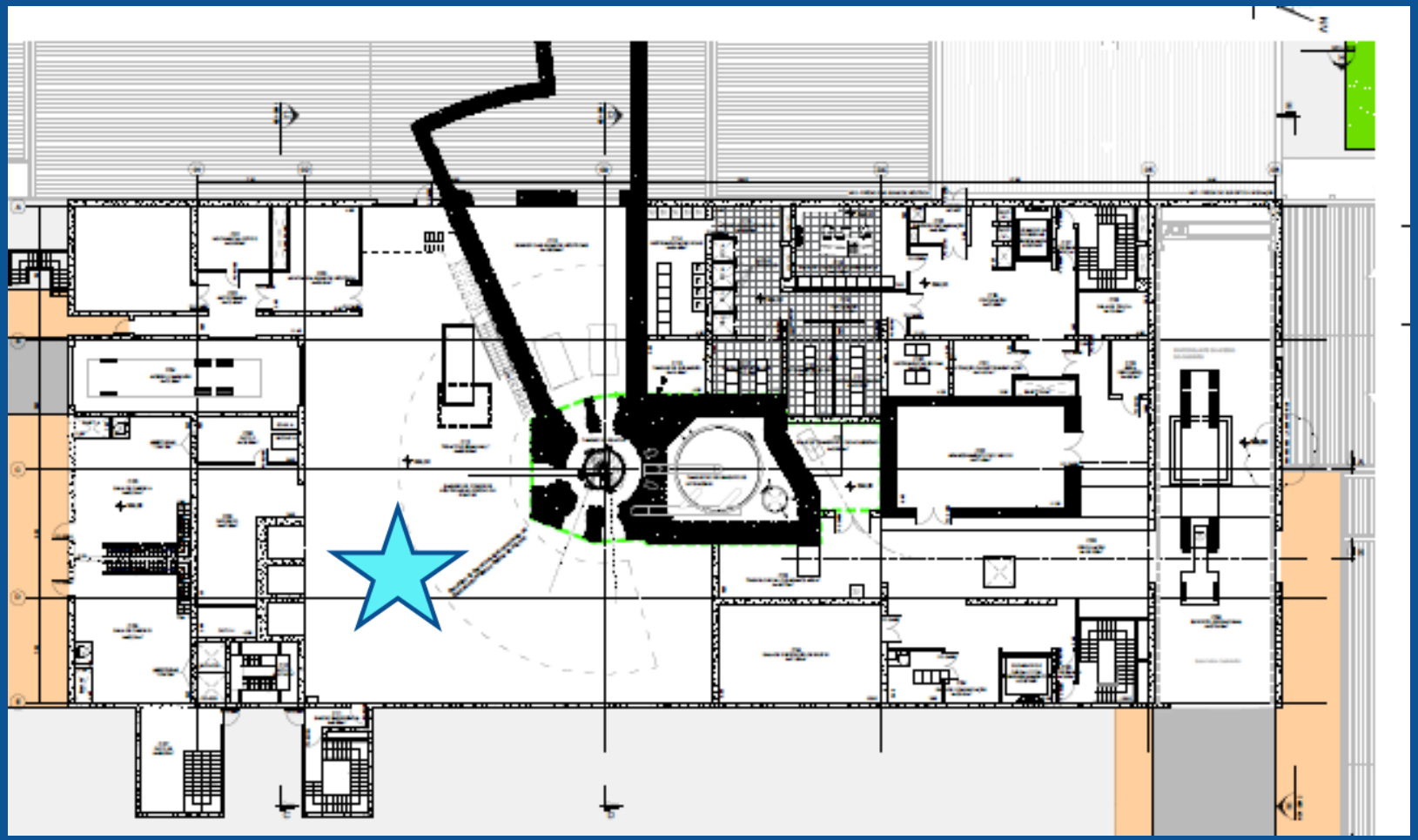
Reactor Experimental Hall



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Thermal Neutrons Beam	
Guide Hall	**Experimental Hall**
High Resolution Diffractometer	Three Axis Spectrometer
High Intensity Diffractometer	Neutron radiography
Laue Diffractometer	
Residual Stress Diffractometer	
Cold Neutrons Beam	
Small Angle Neutron Scattering	
Prompt Gamma Analysis	

Thank You!