



Designing MYRRHA

The world's first research reactor driven by
a particle accelerator

Concept design phase

30 May 2024

What is MYRRHA?

Project Background

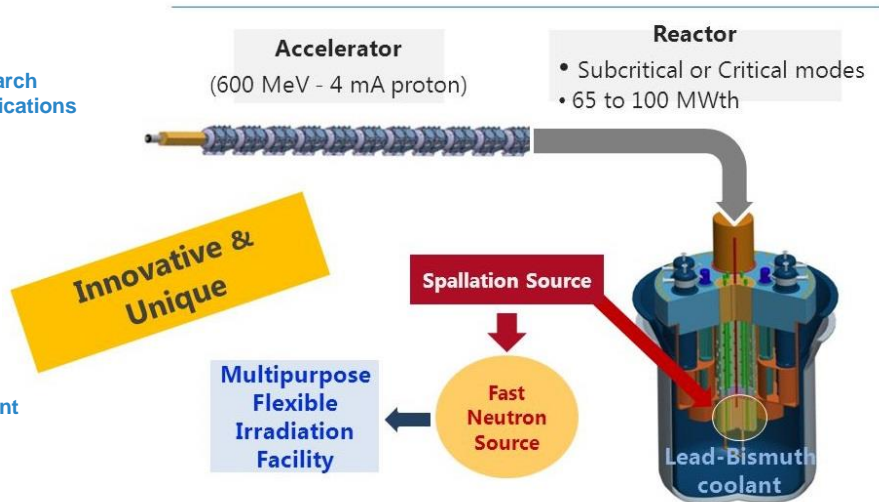
Multipurpose hYbrid Research Reactor for High tech Applications

Unique Features:

- Accelerator Driven
- Pool Type Reactor
- Sub-critical by default
- LBE Coolant

Applications include:

- Nuclear Waste Treatment
- Nuclear Medicine
- Nuclear Science



From A. Hamid, IFMIF Workshop Kyoto January 2014

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Acronym meaning ... **M**ultipurpose **hY**brid **R**esearch **R**eactor for **H**igh tech **A**pplications
MYRRHA is a concept for an innovative nuclear research facility, which is in R and D for more than 20 years, backed by EUR 558 M funding from the government
The project is in Mol, Belgium in the technical Domain of the Client SCK CEN – The Belgian Nuclear Research Institution

MYRRHA will be a sub-critical assembly relying on accelerated protons producing neutrons in the target to achieve periods of criticality in a low-enriched uranium core. It will be an accelerator-driven system in which a proton accelerator will deliver a 600 MeV proton beam to a liquid lead-bismuth (Pb-Bi) spallation target that is in turn coupled to subcritical fast nuclear core.

This is a pool type reactor cooled by 7,800 tons of lead-bismuth eutectic (LBE). All primary systems are within the double walled 16 m high and 10 m wide vessel.

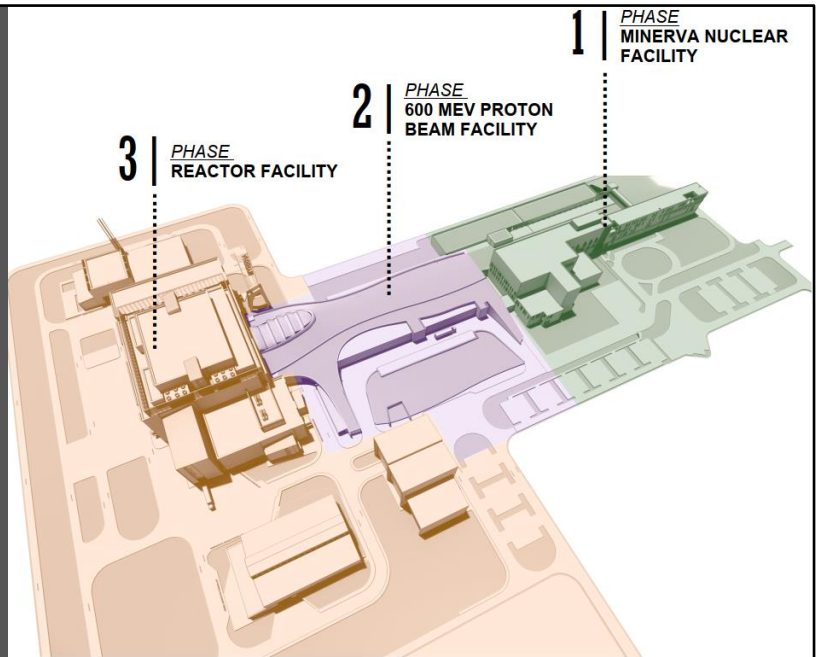
The reactor doesn't contain enough fissile material to maintain the chain reaction. For safety reasons, the reactor design includes passive cooling: in case of electric failure or when the linac is switched off and the reactor comes to an immediate stop, the cooling of the reactor is guaranteed by the natural circulation of the LBE.

Our role

Developing MYRRHA's Masterplan



Architecture and Civil/Structural Engineering for the Reactor Building (Phase 3)



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From the Sofia office of Mott MacDonald, we are developing the concept stage of MYRRHA's overall masterplan, which aims to integrate a large complex of research, nuclear and service facilities, organised into three distinct areas based on their unique purpose, which will subsequently be developed in three different stages/phases as shown on the graphic.

The entire masterplan for the project ranged over an area of 18 ha.

Our focus was on Phase 3 – developing the concept design of the MYRRHA Reactor Building, featured in this presentation.

The challenge

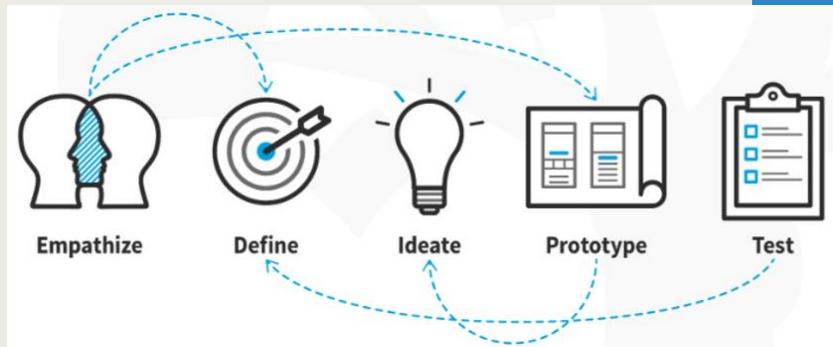
Designing first-of-a-kind building

We are in the process of designing a building to house innovative nuclear installations and scientific activities that are currently in the research and development phase on their own!



The Solution

Applying design thinking approach to the task



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Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. Involving five phases—Empathize, Define, Ideate, Prototype and Test—it is most useful to tackle problems that are ill-defined or unknown.

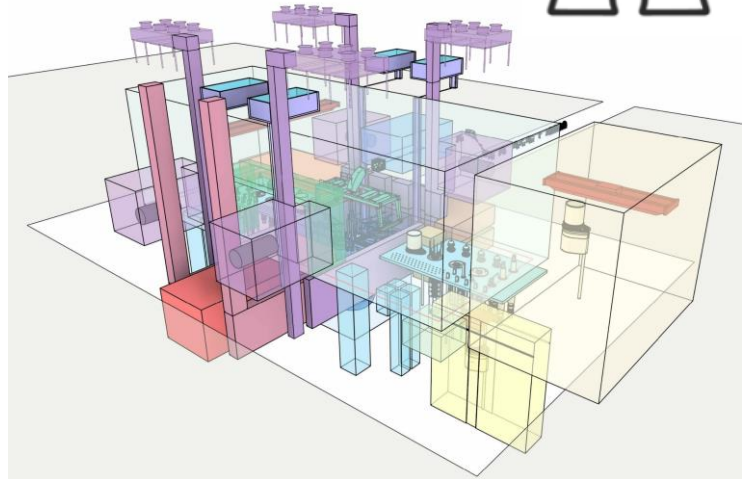
01 Empathize

Engage with the Client's team and understand their needs



How?

- By modelling and illustrating processes and workflows described in scientific reports and diagrams process
- By provoking discussions and pushing Client's team to take decisions taking into account certain physical, spatial and constructability constrains
- By carefully documenting all meetings and workshops to depict all insights and requirements



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Regular meetings with SCK's team of primary system researches/ design coordinators to understand the needs and define project basis. Developing and presenting numerous 3D massing studies and sketches to illustrate various process and interfaces.

02 Define

Establishing major assumptions, requirements, interfaces



How we address it?

- by preparing Basis of Design documents for the Building Architecture, Civil and Structural and Masterplan Disciplines
- By creating/updating extensive Project Requirements Database and Master list of Assumptions



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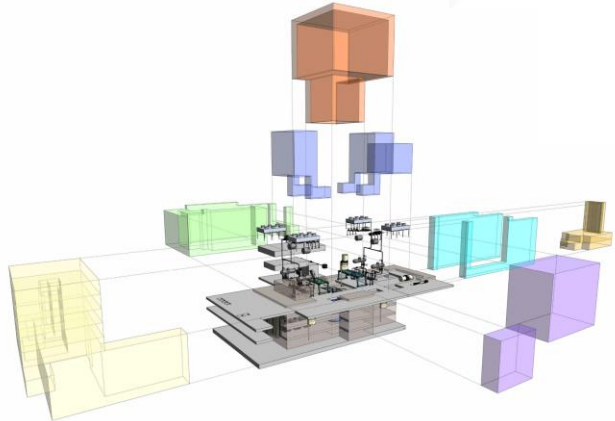
03 IDEATE

Functional schemes and multiple massing studies



Our approach...

- multiple options for the general arrangement of the reactor building were tested
- incorporating and clarifying spatial relationships of the primary processes and workflows which are already sufficiently defined



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04 THE BUILDING PROTOTYPE

Maximizing the use of BIM (Building Information Modeling) technologies



The result:

- 85 000 m2 Build-up Area
- 6 Levels above ground
- 4 Underground Levels
- 40M Total Height
- 553 Rooms/Spaces



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We developed the design and the project deliverables utilising the most advanced BIM technologies, which played a key role for the successful project delivery.

MYRRHA Reactor Building



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MYRRHA

Multi-purpose hYbrid Research Reactor for High-tech Applications

project by



sck: cen

architectural
concept design



MYRRHA's architectural concept design

Mott MacDonald, 2023

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Here I will show you a short video.



At the end I am sharing with you a rendering from the phase 01 of the development.

We're designing two key facilities for the programme: the Proton Target Facility – which will produce innovative radioisotopes for medicine and fundamental physics research – and the Full Power Facility, which will conduct experiments to test materials for fusion using proton beam energy. These facilities will be accompanied by a combined service area which generally houses the more conventional functions such as change rooms, laboratories, office space, plant rooms, etc.

Construction is scheduled to start at the end of this year.



Thank you