MYRRHA, the Belgian Prototype that fascinates the World

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FR-22 Conference, hybrid mode

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Outline

- **Context – What is MYRRHA ?**
- **A Non Profit Organisation exists now !**
- **Our implementation strategy**
- **Recent update on the reactor part of the installation.**

MYRRHA: Accelerator Driven System

Phase 1

100 MeV

Linear accelerator

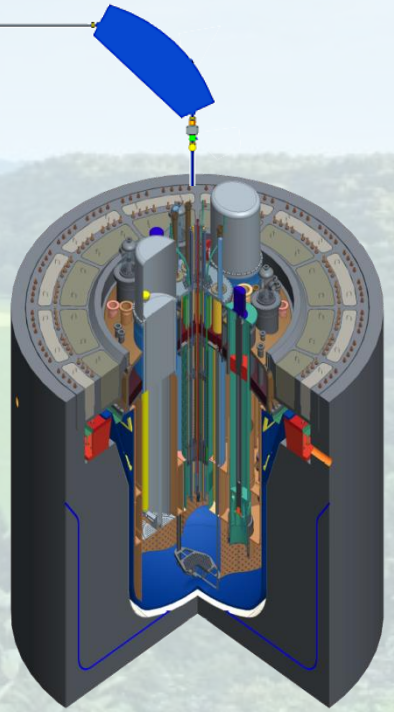
Phase 2

600 MeV

- ✓ Transmutation demonstration
- ✓ ADS at pre-industrial scale
- ✓ Flexible irradiation facility

Phase 3

Reactor

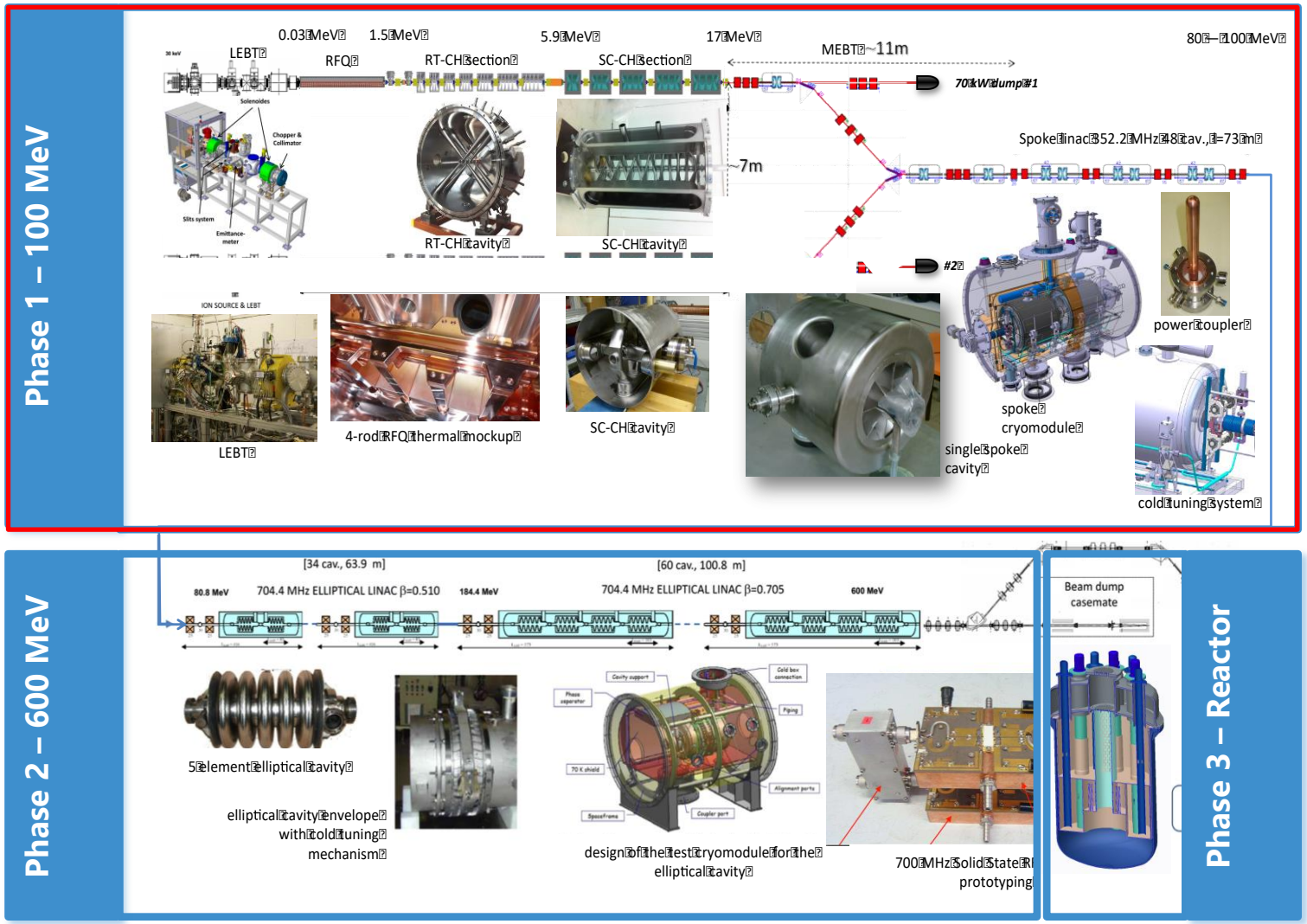


MYRRHA's phased implementation strategy

UNDER CONSTRUCTION

Phased approach benefits:

- Reduced technical risk
- Spreading investment cost
- First R&D facility available in Mol end of 2026



Source: SCK CEN MYRRHA Project Team

Applications	Description	MYRRHA phase 1 2026	MYRRHA phase 2 2032	MYRRHA phase 3 2036
	**Spent fuel transmutation** >> Reduce radio-toxicity: • in volume (factor 100) • in duration (factor 1,000 from 300,000 years to 300 years)	✗	✗	✓
	**Innovative radioisotopes** Produce new diagnostic and therapeutic medical isotopes for research and clinical use	✓	✓	✓
	**Fundamental research** A landmark project on the ESFRI high priority list contributing a.o. to fundamental research in nuclear physics science and nuclear medicine	✓	✓	✓
	**Fusion energy** Conducting advanced materials research, qualification and testing for fusion energy	✓	✓	✓

Belgian Government decision of 7 September 2018

Decision to build MYRRHA as large new research infrastructure in Mol, Belgium

Belgium **allocates** € 558 m for 2019-2038

- € 287 m for 2019-2026: construction of MINERVA (linac 100 MeV + PTF & FTS)
- € 115 m for 2019-2026: design, R&D and licensing for Phases 2 (extended linac 600 MeV) & 3 (reactor)
- € 156 m for 2027-2038: MINERVA operations (linac 100 MeV)

Establishment of **international non-profit organisation**

MYRRHA AISBL/IVZW

Government support for establishing MYRRHA partnerships

Belgium appoints cabinet ministers to promote and negotiate international partnerships

Source: Belgian minister of Energy, Environment & Sustainable Development

Belgian Government decision of 7 September 2018
Confirmed on 23 July 2021 (+ creation of MYRRHA NPO)

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Establishment of **international non-profit organisation**

MYRRHA AISBL/IVZW

Decided 23.07.2021

Created 17.09.2021

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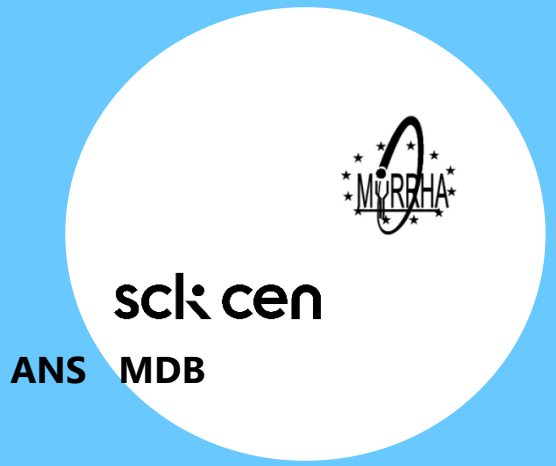


MYRRHA International nonprofit organisation

MYRRHA AISBL is a separate legal entity needed to find external partners/investors

Responsabilities :

- For SCK CEN
  - Design & build MINERVA (phase 1)
  - Conduct R&D for phases 2 (Accelerator - 600 MeV) & 3 (MYRRHA Reactor)
  - Obtain licenses for Phase 1 and later on for Phases 2 & 3
  - Being the nuclear operator of MYRRHA/MINERVA
- For MYRRHA AISBL
  - Establish the MYRRHA International Consortium
  - Guarding the overall scope of MYRRHA programme

20/09/2021

The AISBL has been set up: MYRRHA welcomes international partners

"MYRRHA AISBL is a reality!", enthuses Hamid Aït Abderrahim, Deputy Director-General of SCK CEN and Director of MYRRHA. The deed of incorporation was signed on Friday. "17 September therefore marks the start of a new era for MYRRHA. One in which we can officially join forces with international partners to achieve our ambitions and goals!"

MYRRHA will become the world's first research reactor powered by a particle accelerator, and will tackle societal challenges that confront all countries. "This includes nuclear waste treatment or the fight against cancer with a new generation of medical radioisotopes, or fundamental materials research for nuclear fusion, among other things. International cooperation is essential if we are to come up with

MYRRHA Reactor: implementation in 2036

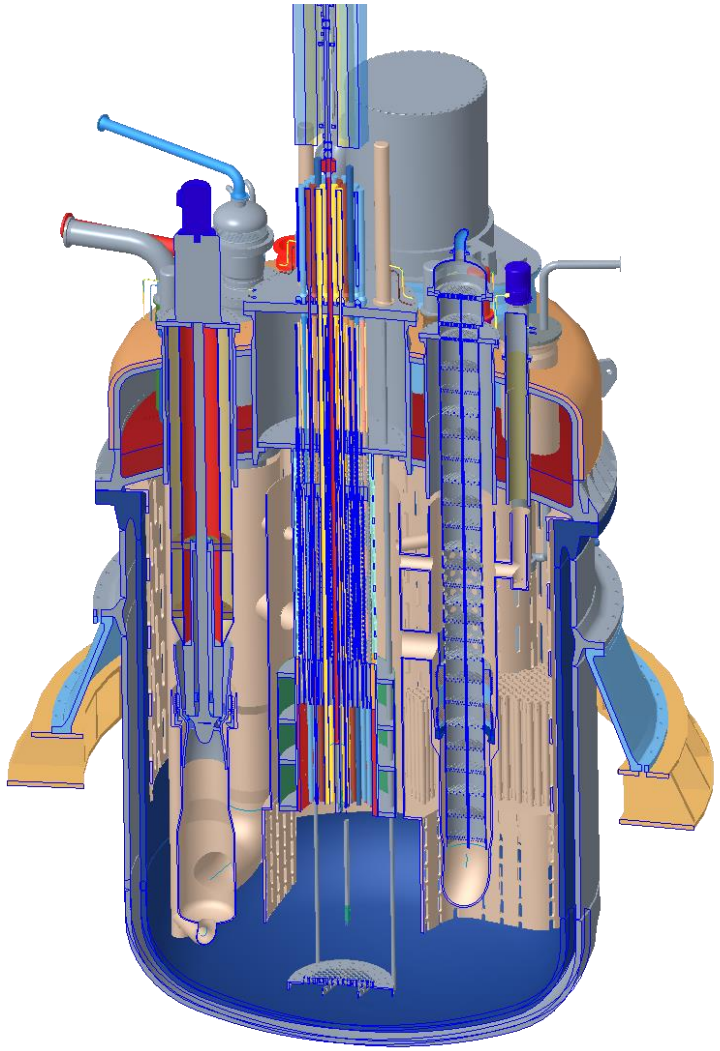
Objectives = transmutation + radioisotopes + fusion material R&D + technology platform

Source:

MYRRHA reactor primary design Rev. 1.8, frozen end 2020

- Integrated Pool-type concept with LBE coolant
- Fuel assemblies: hexagonal bundles of cylindrical wire-spaced fuel pins (MOX fuel 30wt.% Pu)
- 4x heat exchangers: double-walled with leak detection; water/steam on secondary side
- 2x primary pumps: vertical shaft mixed-flow design
- Bottom core loading: single in-vessel fuel handling machine (IVFHM)
- Safety vessel integrated into the primary vessel

Parameter	Unit	Value
Maximum core power	MW_{th}	64
Maximum heat sink rated power	MW_{th}	70
Shutdown state LBE temperature	°C	200
Maximum core inlet LBE temperature	°C	220
Maximum average hot plenum LBE temperature	°C	270



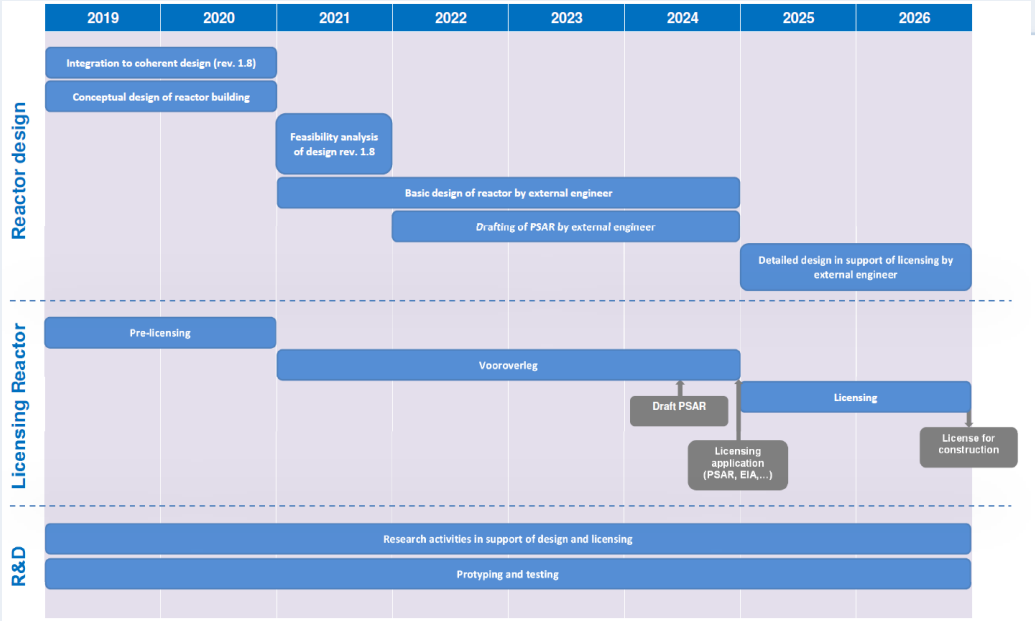
Source:

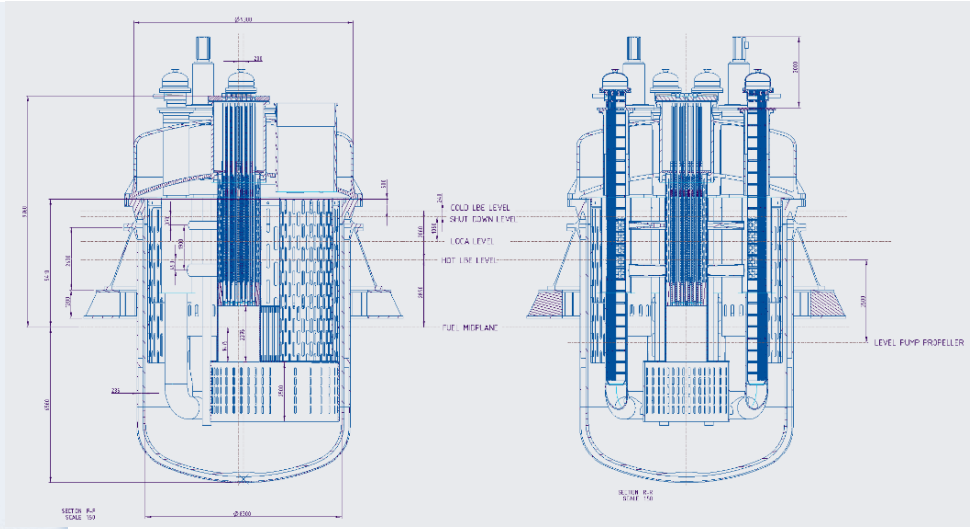
Revision 1.8 in numbers

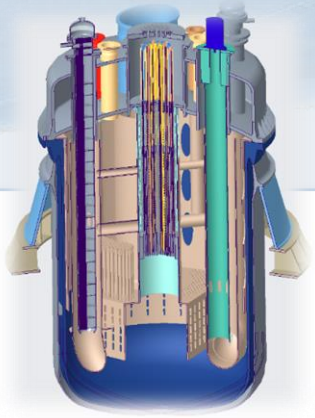
Parameter	Unit	Rev. 1.6	Rev. 1.8
Max. Core Power	MW_{th}	100	64
Design power	MW_{th}	110	70
Vessel diameter	m	10.2	8.3
Vessel height	m	15.9	11.9
Total reactor height	m	20.2	16.3
Longest component length (Pump)	m		14
LBE inventory	m^3	725	525[1]
Total mass	ton	10000	6682[2]

- [1] 2000 ton reduction in LBE coolant for the LBE coolant compared to Rev. 1.6
- [2] 1300 ton reduction in steel mass

MYRRHA reactor, Planning







- **2020**
  - Description of Rev. 1.8 concept, including the reactor building
  - Final report of the pre-licensing phase
  - R&D Status report
- **2022 – Stage-Gate**
  - Conceptual design
  - Commitment of consortium partner
- **2024 – Stage-Gate**
  - Feasibility of conceptual design
  - Positive advice from safety authorities
- **2026**
  - Basic design with consortium partner
- **2030**
  - Building permit

SCK CEN
Belgian Nuclear Research Centre

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Fondation d'Utilité Publique
Foundation of Public Utility

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