



News from MYRRHA and MINERVA in MYRRHA Phase 1

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October 22nd 2018, MYRTE WP2 7th meeting, CERN

Belgian Government decision on September 7, 2018

- Belgium decided to build a new large research infrastructure at Mol → MYRRHA.
- Belgium allocated 558 M€ for the period 2019 – 2038:
 - 287 MEUR investment (Capex) for building MINERVA (Accelerator up 100 MeV + PTF) for 2019 - 2026
 - 115 MEUR for further design, R&D and Licensing for phases 2 (accelerator up to 600 MeV) & 3 (reactor) for 2019-2026.
 - 156 MEUR for OpEx of MINERVA for the period 2027-2038
- Belgium requests to establish an International non-profit organization (AISBL/IVZW) in charge of the MYRRHA facility for welcoming the international partners.
- Belgium continues to mandate Secretary of State for Foreign Trade Mr. Pieter De Crem for promoting MYRRHA and negotiating international partnerships.

Brief recent history of ADS activity in Europe

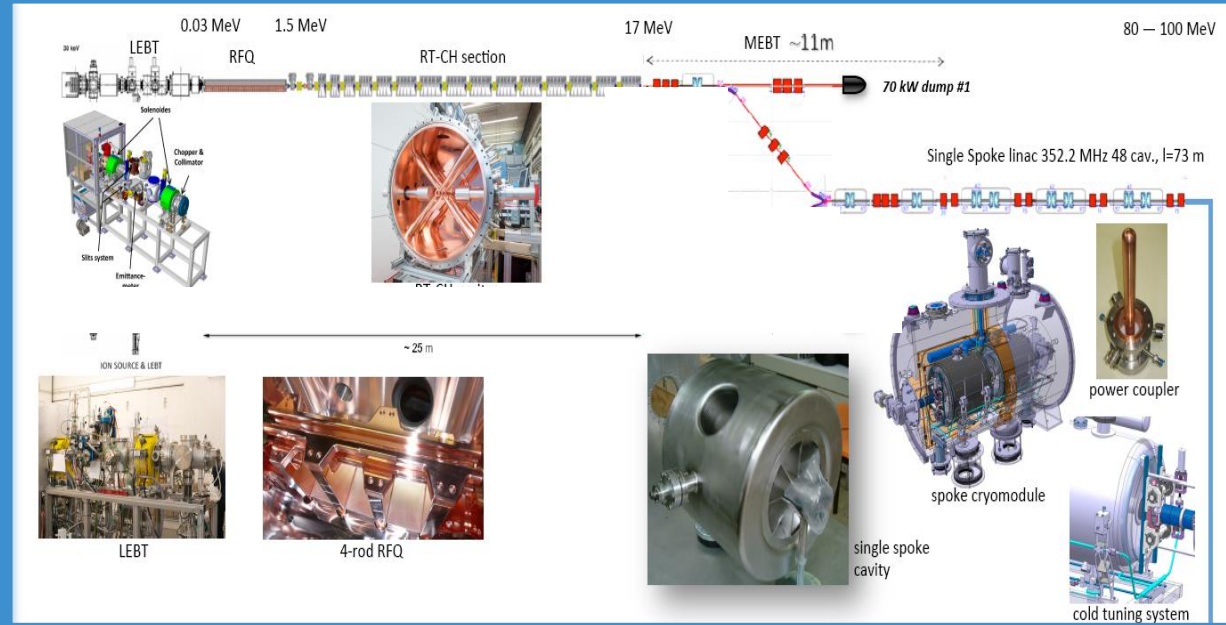
- 1993 C. Rubbia, energy amplifier (CERN)
- 1994 H. Aït Abderrahim & Y. Jongen, ADONIS (BE)
- **1995 M. Salvatores, MUSE experiments (FR)**
- **1995 C. Rubbia et al., FEAT/TARC experiments (CERN)**
- 1996 C. Rubbia et al., EA-80 ADS Demo joint programme ENEA, Ansaldo Nucleare, INFN (IT)
- 1998 H. Aït Abderrahim et al., MYRRHA (BE)
- 1999 B. Carlucci & M. Salvatores et al., EFIT-Gas AREVA,-CEA (FR)
- 2001 C. Rubbia et al., TRADE ENEA-Casaccia (IT)
- **2001 A. Kievitskaya et al., YALINA experiments (Belarus)**
- 2002 V. Shvetsov et al., SAD facility in DUBNA (JINR/Russia)
- **2007 H. Aït Abderrahim et al., GUINEVERE (BE/FR)**
- **2010 H. Aït Abderrahim et al., MYRRHA in ESFRI & BE-Gov. Declaration support for construction (BE)**
- 2011 A. Zelinsky et al., Neutron Source based ADS at KIPT (Ukraine)
- 2015 iTheC, iTheC ADS Project at INR in Troitsk (CH/RU)
- **2018 H. Aït Abderrahim et al., BE-Gov. decides the start of construction of MYRRHA and opens it to international participation**

MYRRHA Phased Implementation Strategy

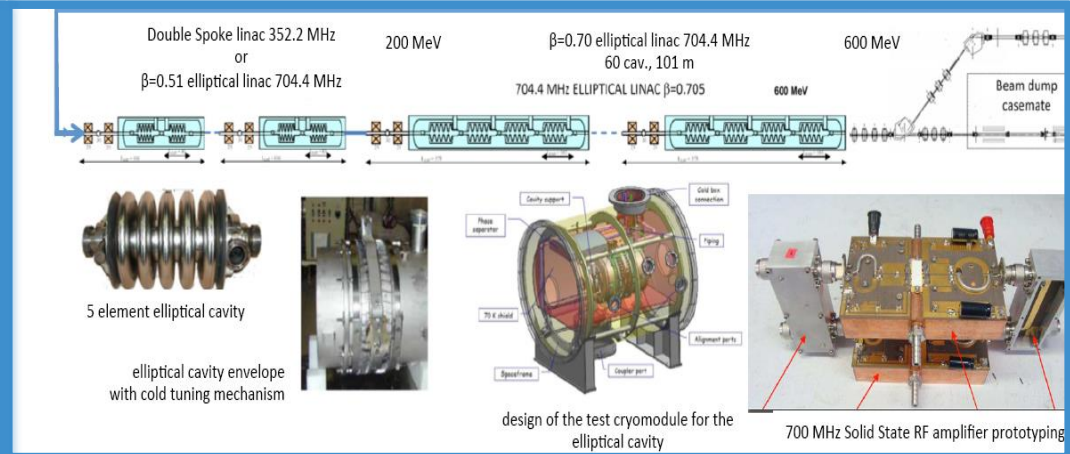
Benefits of phased approach:

- Reducing technical risk
- Spreading investment cost
- First R&D facility available in Mol in 2026

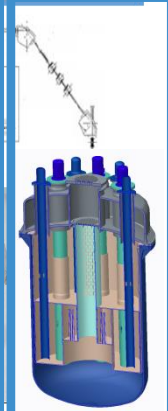
Phase 1 – 100 MeV



Phase 2 – 600 MeV



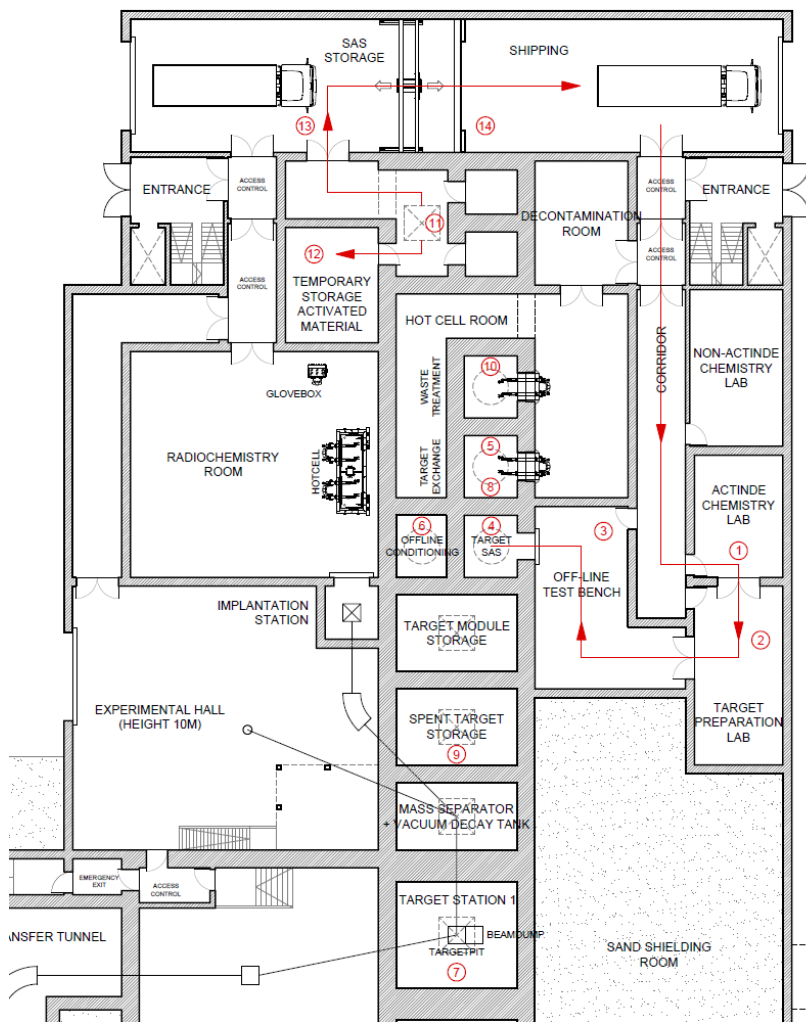
Phase 3 – Reactor



MYRRHA Phase 1 - 100 MeV linac

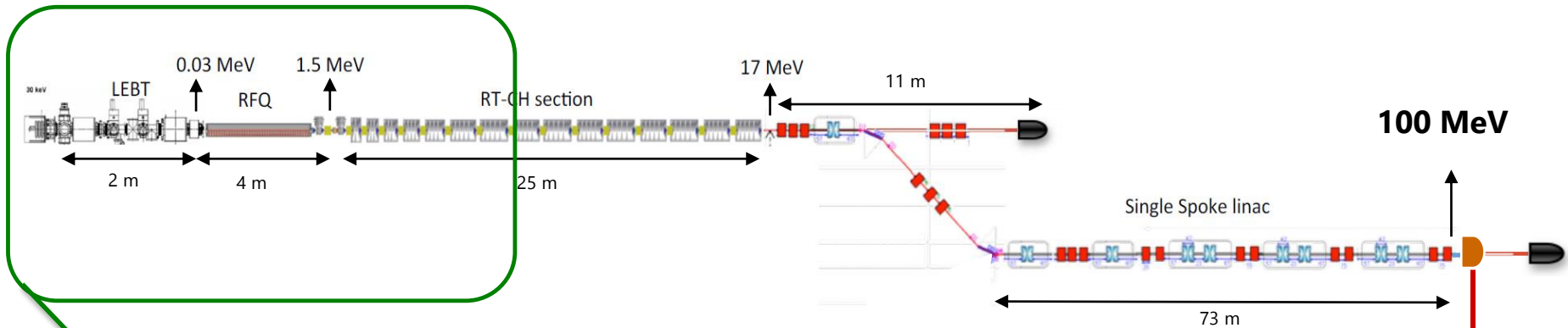
- **Representative unit** of the full MYRRHA linac (600 MeV)
- **Objectives**
 - Implementation of **fault tolerant schemes**
 - Validation of the **technological choices** (for the injector)
 - Evaluation of the **reliability goal** for the **full MYRRHA linac**
- **Applications in MINERVA**
 - Make use of an extreme accelerator reliability, CW, high intensity proton beam (up to 4 mA)

MINERVA: a 100 MeV linac + the Proton Target Facility (Acc. Reliab., RI, ISOL Physics, Fusion Mat. R&D)



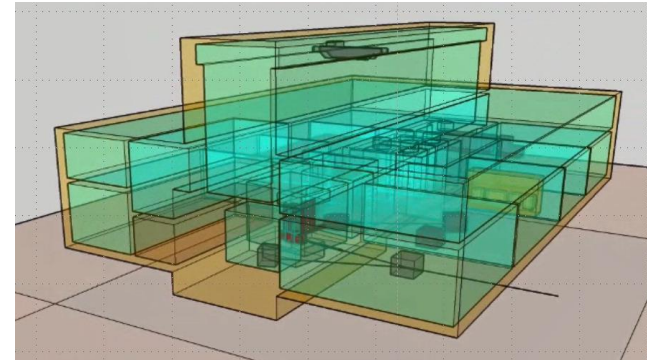
MINERVA in MYRRHA Phase 1 Schematic View

100 MeV proton linac



At SCK•CEN vault @CRC/LLN up to 5.9 MeV

***A fraction of the beam redirected
to the target facility***

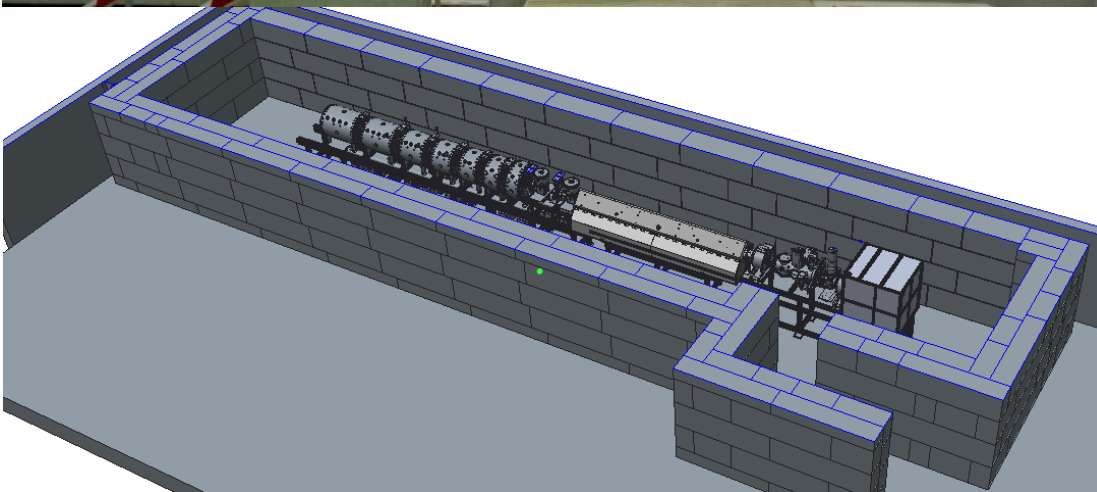


100 MeV accelerator status

- Today we have a fully coherent 100 MeV linac design
 - Components prototyping considered as terminated
 - Proven technical solution for all critical components
 - Fault tolerant beam dynamics
 - Collaboration framework
 - Confidence
- Integrated prototyping on-going
 - Test platforms: combining components and techniques
 - Make beam (@ low energy)
 - Profit from the modularity

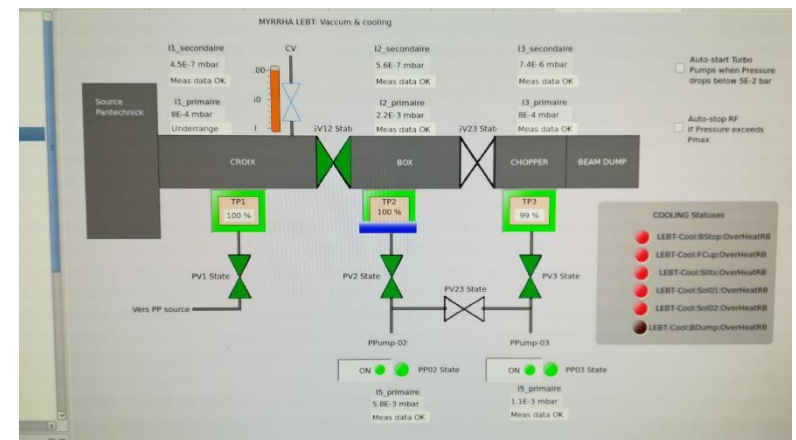
Injector @ SCK·CEN bunker at CRC/UCL in Louvain-la-Neuve

Phasing the construction and the commissioning of the 100 MeV accelerator



MINERVA in MYRRHA Phase 1 - Accelerator

- New Key personnel in 2018 :
 - Licensing - Zjef Beelen
 - Safety - Dahmane Mazed
 - MPS & Faults delivery - Aurelien Ponton
- R&D and prototyping at component level achieved
- Integrating prototyping on-going : Source & LEBT installed and vacuum tests on-going
- Design of beam dumps & Shielding for LLN on-going
- Tenders launched/in preparation
- Components under fabrication
- Components under tests

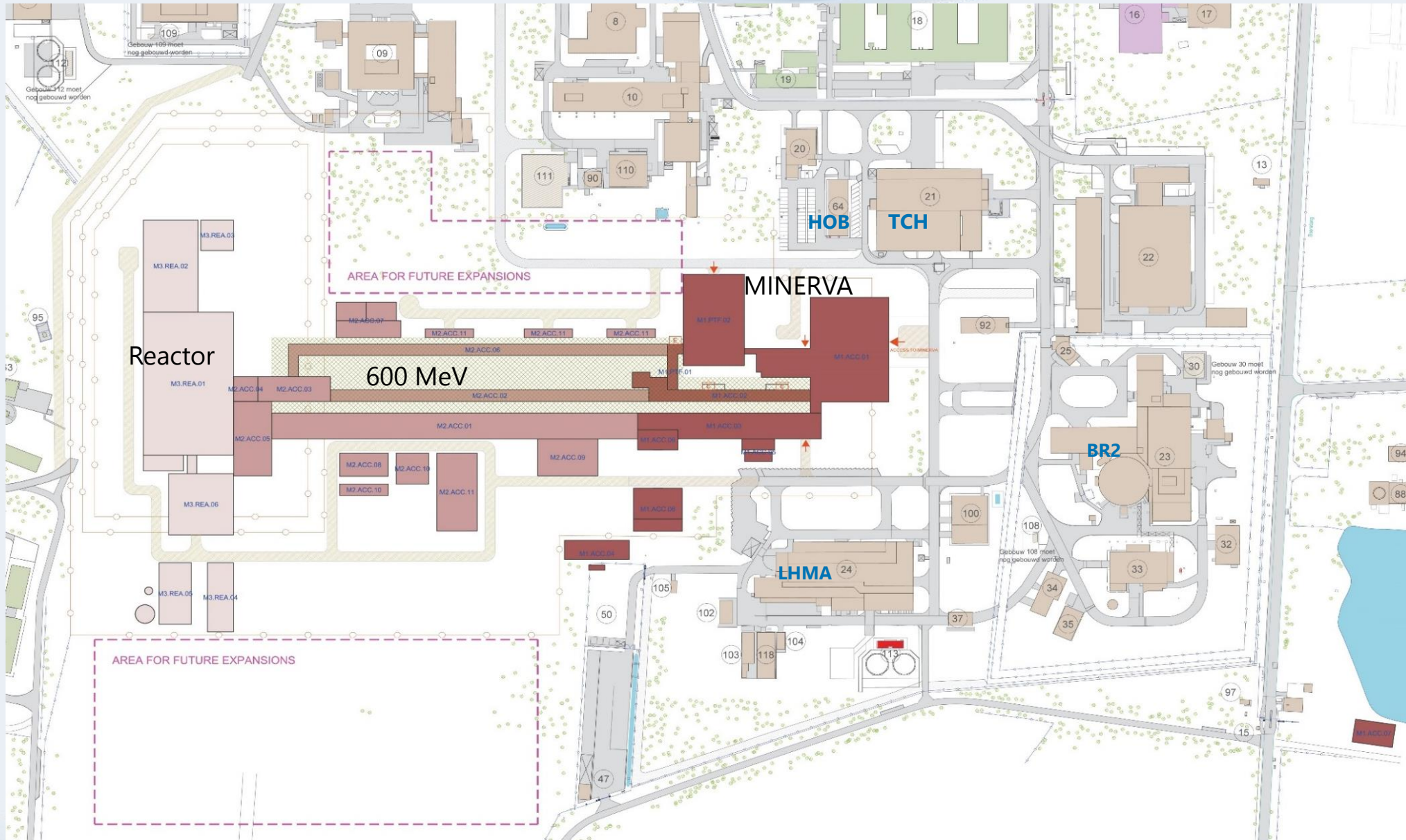


MINERVA in MYRRHA Phase 1 - Proton Target Facility

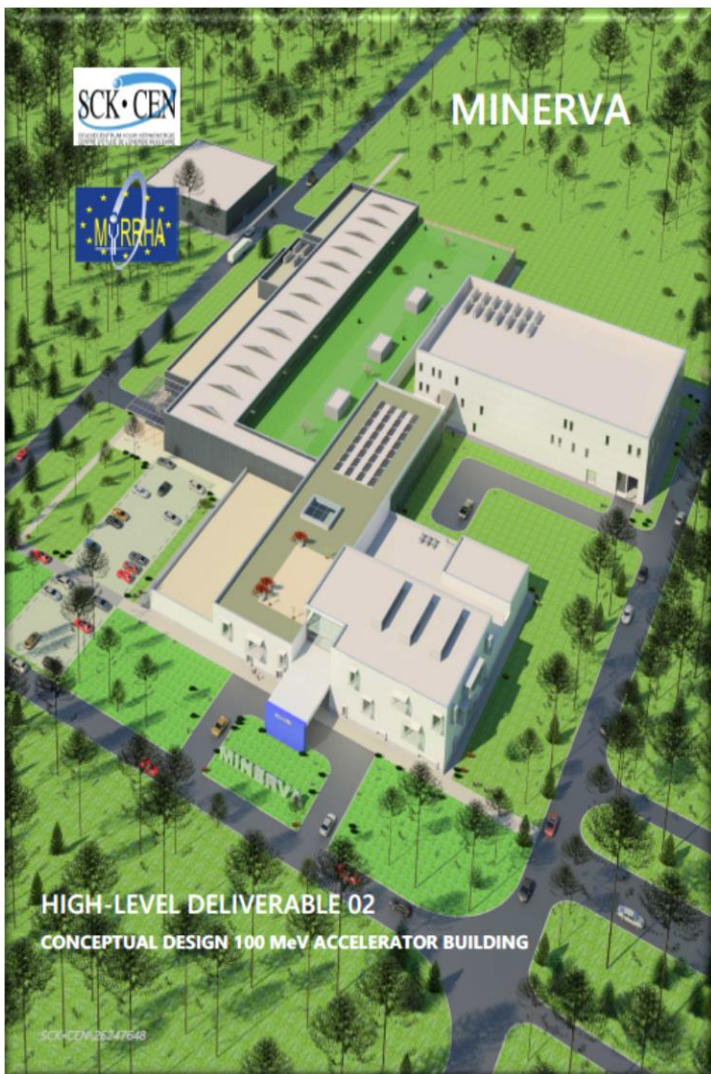
- Facility is defined, three irradiation stations:
 - an ISOL-target station for production of RIBs
 - a multipurpose irradiation pit to allow the development of future applications
 - a dedicated irradiation station for research and qualification for material for fusion at large
- PTF Conceptual design on-going to launch the engineering for detail design and construction
- Physics cases identified through a series of topical workshops within BriX (**B**elgian **R**esearch **I**nitiative on e**X**otic nuclei for atomic, nuclear, and astrophysics studies)
- Physic case for the ISOL facility at 100 MeV defined
- Build of user community



Project Masterplan at SCK·CEN site



100 MeV accelerator buildings & auxiliary systems



- Conceptual design ✓
 - Masterplan
 - Process systems
 - HVAC & dynamic confinement
 - Building architecture
 - Civil & Structural engineering
 - Electrical systems and I&C
 - Integration, 3D model
 - Safety and security in design

MINERVA
team
SCK•CEN

- Basic design
- Detailed design, incl. lots descriptions
- Follow-up of construction

Design Engineer
call launched,
companies
selected,
Granting phase
on-going

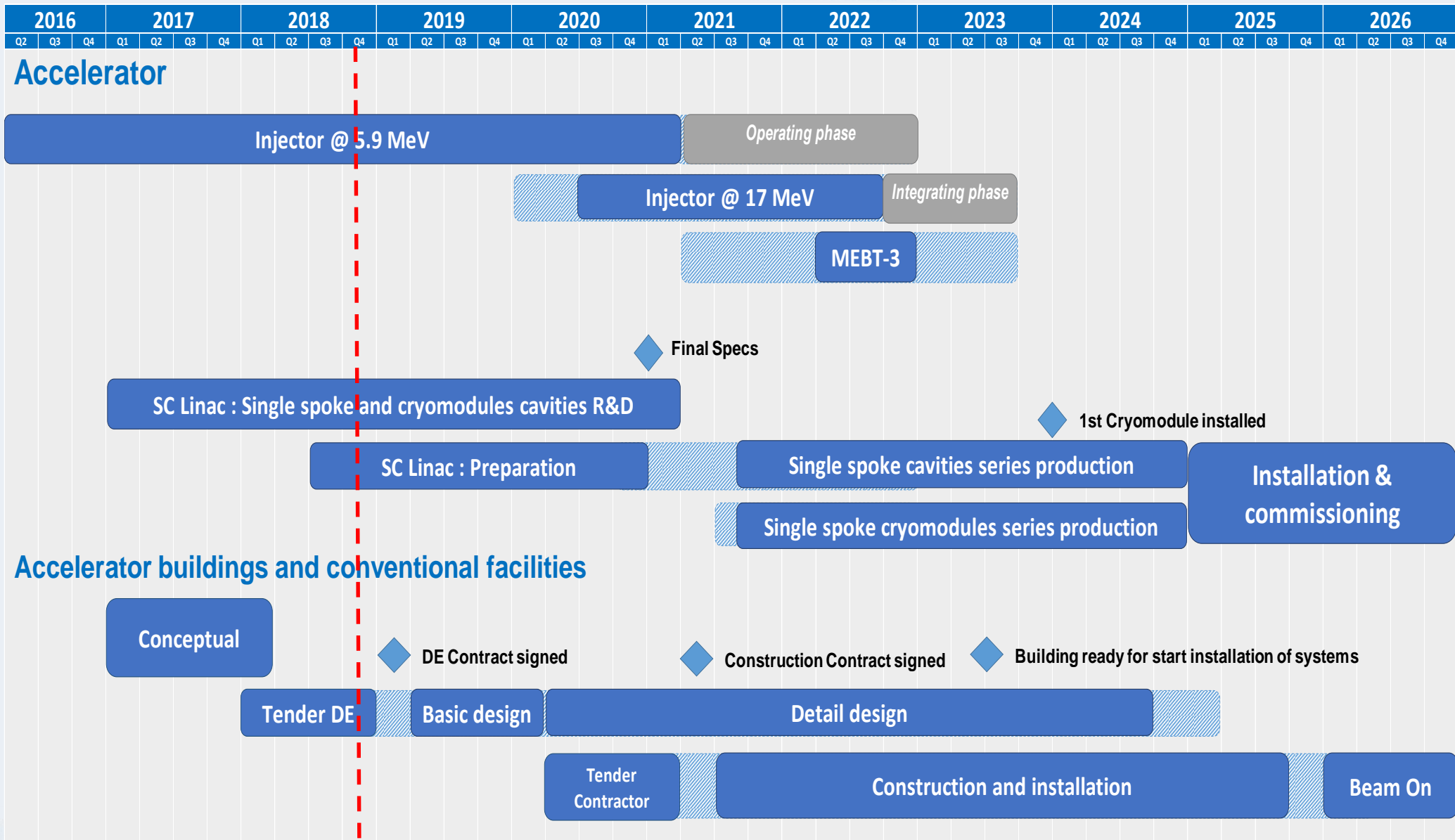
Licensing

- MYRRHA :
 - Significant progress has been achieved in the pre-licensing framework with the Belgian Safety Authorities
 - **First opinion on licensability (of full MYRRHA) received in 2017: No show stopper encountered so far**
- MINERVA :
 - Licensing started in 2016
 - Consultation with Belgian Safety Authorities (FANC) on-going
 - Preliminary Safety Assessment Report (PSAR)
 - Studies included are defined
 - Work on-going
 - Key personnel: Licensing Manager

MINERVA Selected Project Management related aspects

- This is a large infrastructure involving both R&D and engineering practices
 - ***emphasis in integration and optimisation***
- Project organisation & planning and key milestones (2018 – 2026) defined
- Resources defined, hiring of key roles strengthened (hiring plan)
- A coordinated procurement of components and Design Engineer contracts
- Industrialisation phase: serial production and tests platforms
- This is a facility to be built in a nuclear research centre
 - *Dialogue with Belgian Safety Authorities on-going: PSAR and EIA*
- *Last but not least*, continuous integration of national and international collaborations

MINERVA 100 MeV Accelerator high-level schedule



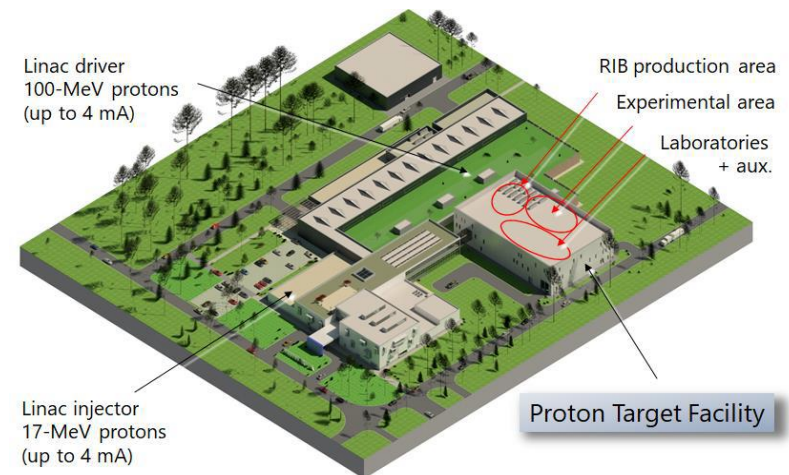
Conclusion

- MYRRHA main objective is the **demonstration of transmutation** as a viable solution to reduce the radiotoxicity of long-life nuclear waste → one of the 4 building blocks of **EU strategy for P&T**.
- MYRRHA is benefiting from **SCK•CEN continuous support** since 1998, has been **endorsed by Belgian Government** since 2010 and has been supported by a dedicated financial endowment.
- **On Sept 7th, 2018: Belgian Government decision with 558 MEuros to fund MYRRHA Phase 1**
- MYRRHA profits since 2001 from the **results of many projects** co-funded by the European FP
- MYRRHA R&D programme involves **more than 100 engineers and researchers** at SCK•CEN and collaborations with national and international industry, research centres and academia.
- MYRRHA **phased implementation strategy** allows reducing technical risk, spread of investment cost

MINERVA

R&D infrastructure in Mol by 2026

- Demonstrate accelerator reliability for MYRRHA ADS
- Deliver intense proton beams to target facilities for
 - 1) production of isotopes for innovative research and medicine and 2) fusion research



All this is possible thanks to fantastic people we have at SCK•CEN and in our international MYRRHA network



Innovation in Belgium for Europe and beyond for sustainable & innovative nuclear energy and applications





Thank you for your attention !

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