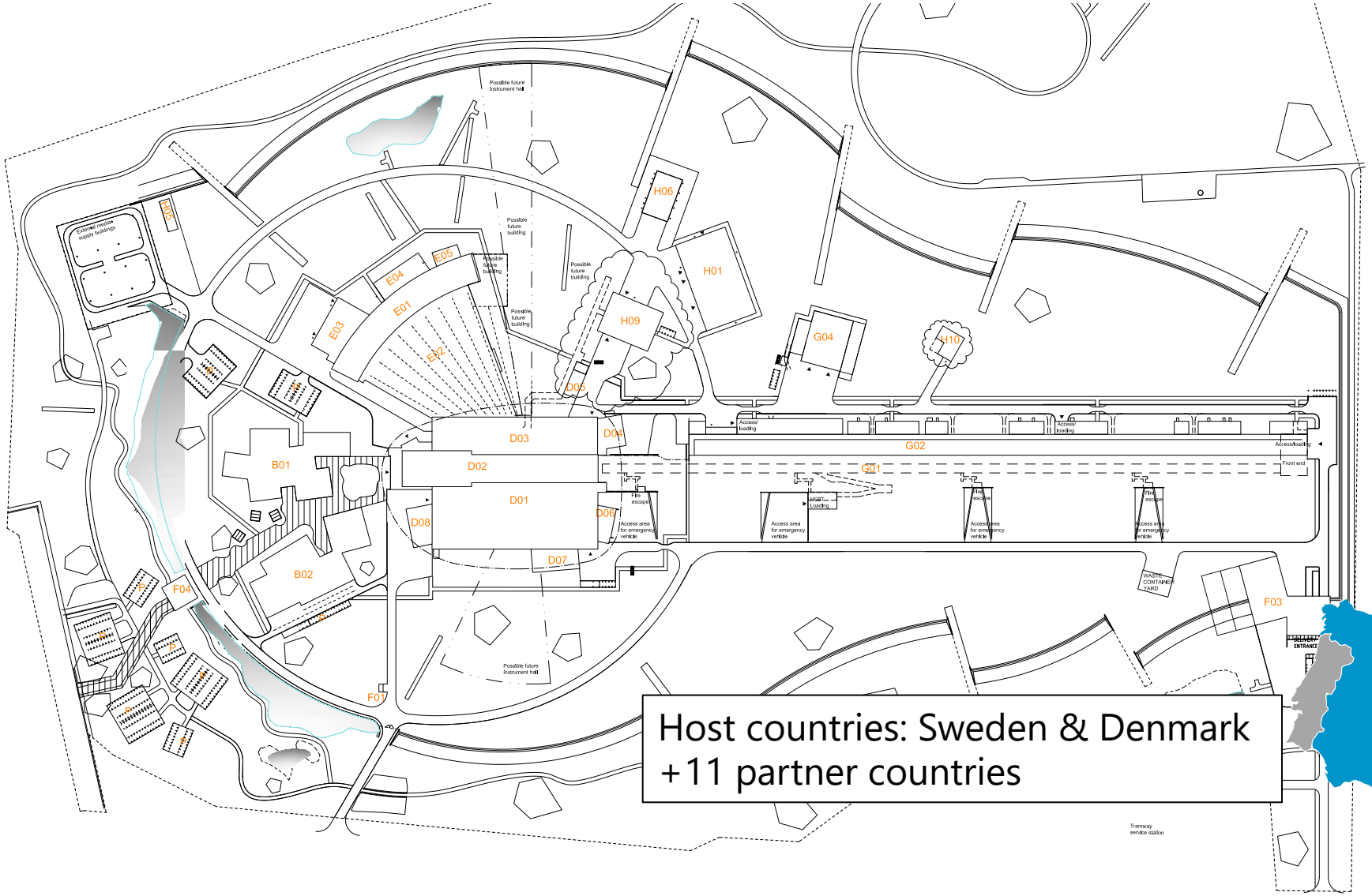
EUROPEAN
SPALLATION
SOURCE

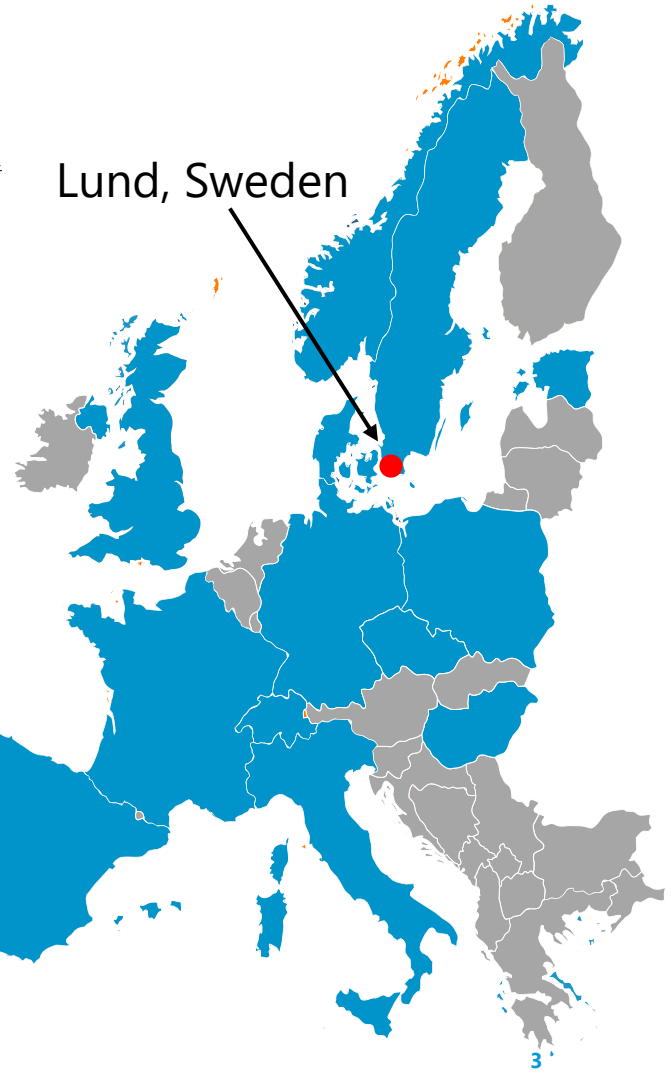
ESS Update

ANDREAS SCHREYER

2022-10-05

ESS: The Next-Generation Neutron Source





Host countries: Sweden & Denmark
+11 partner countries

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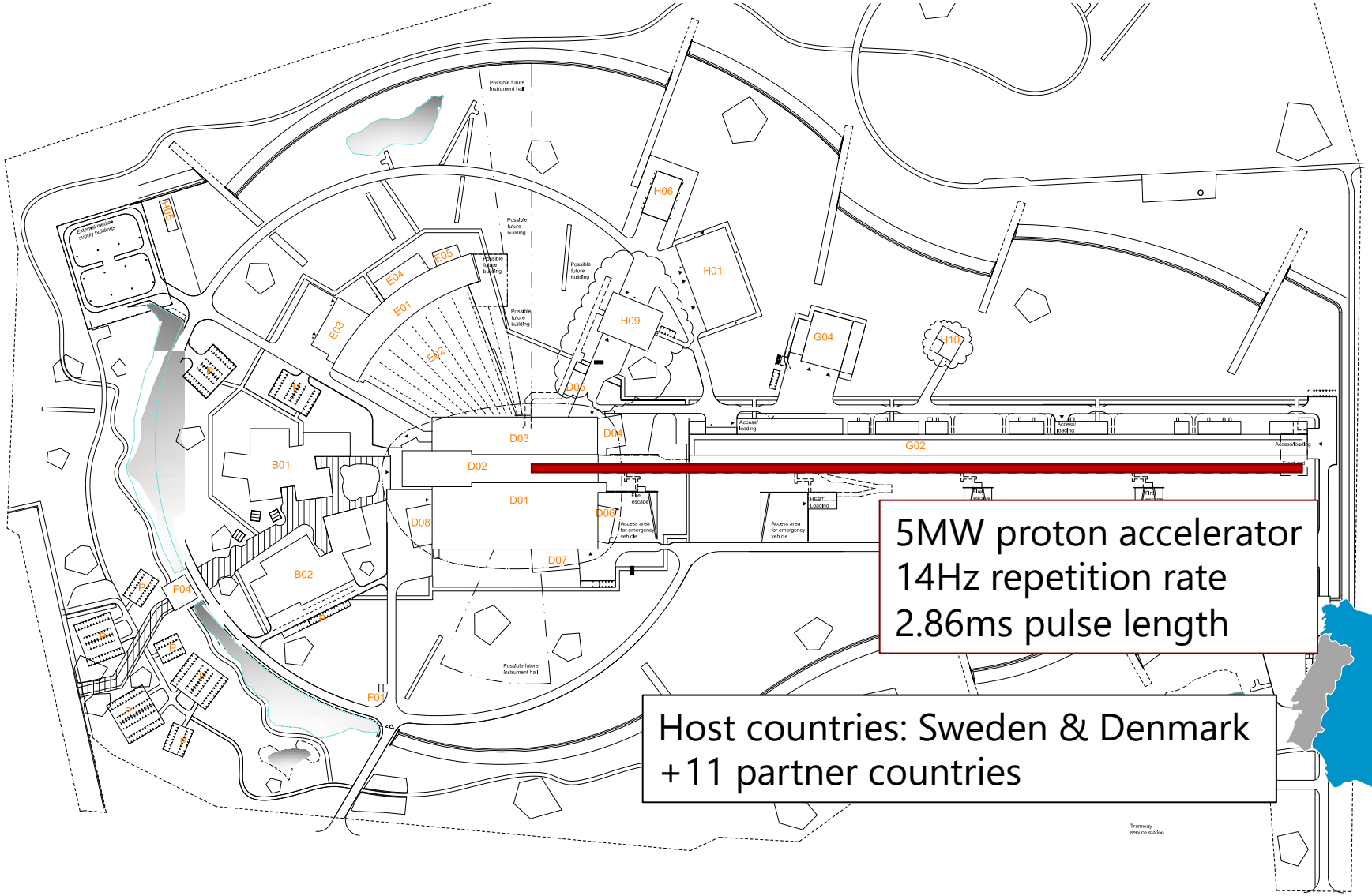
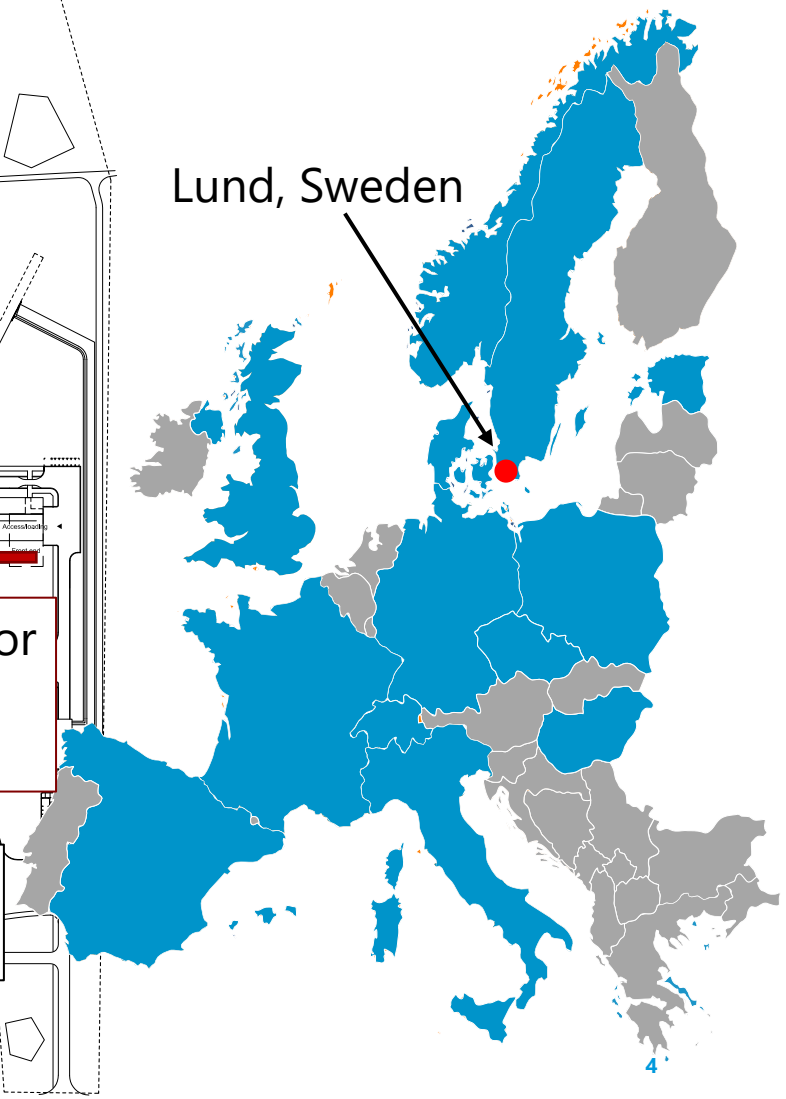


5MW proton accelerator
14Hz repetition rate
2.86ms pulse length

Host countries: Sweden & Denmark
+11 partner countries



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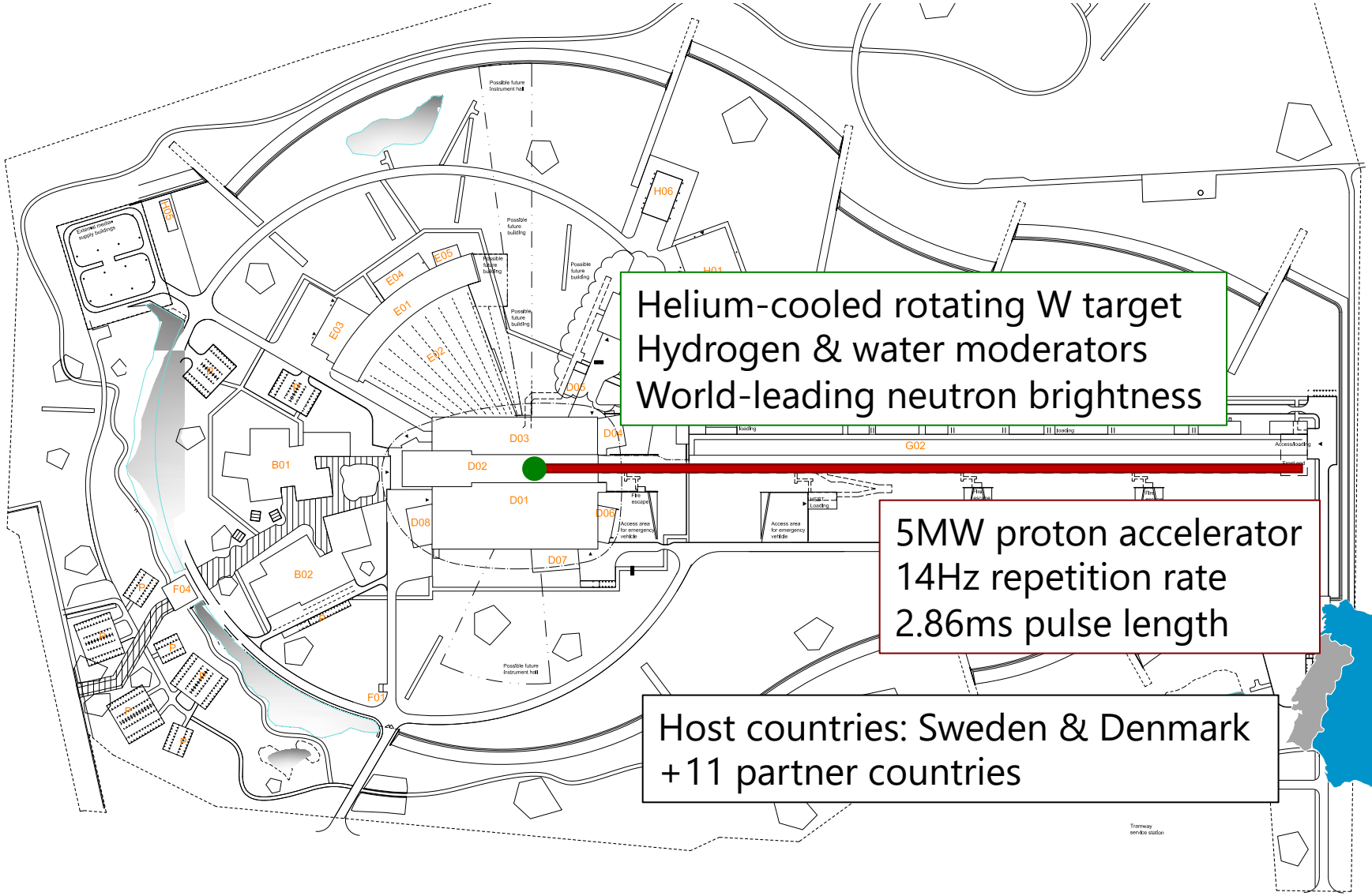
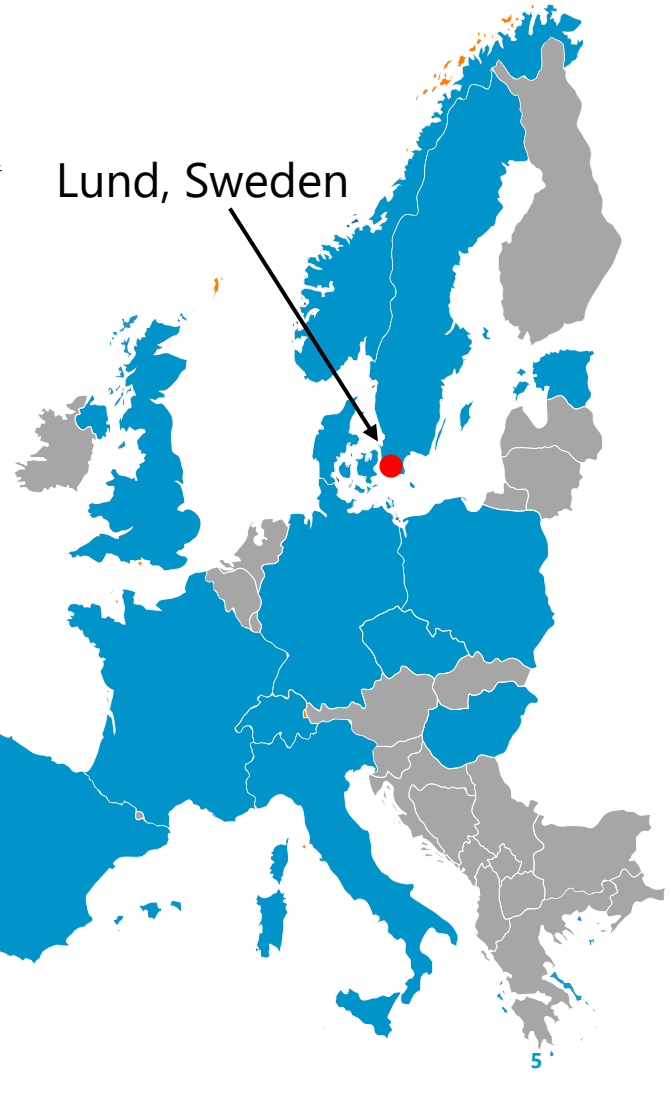
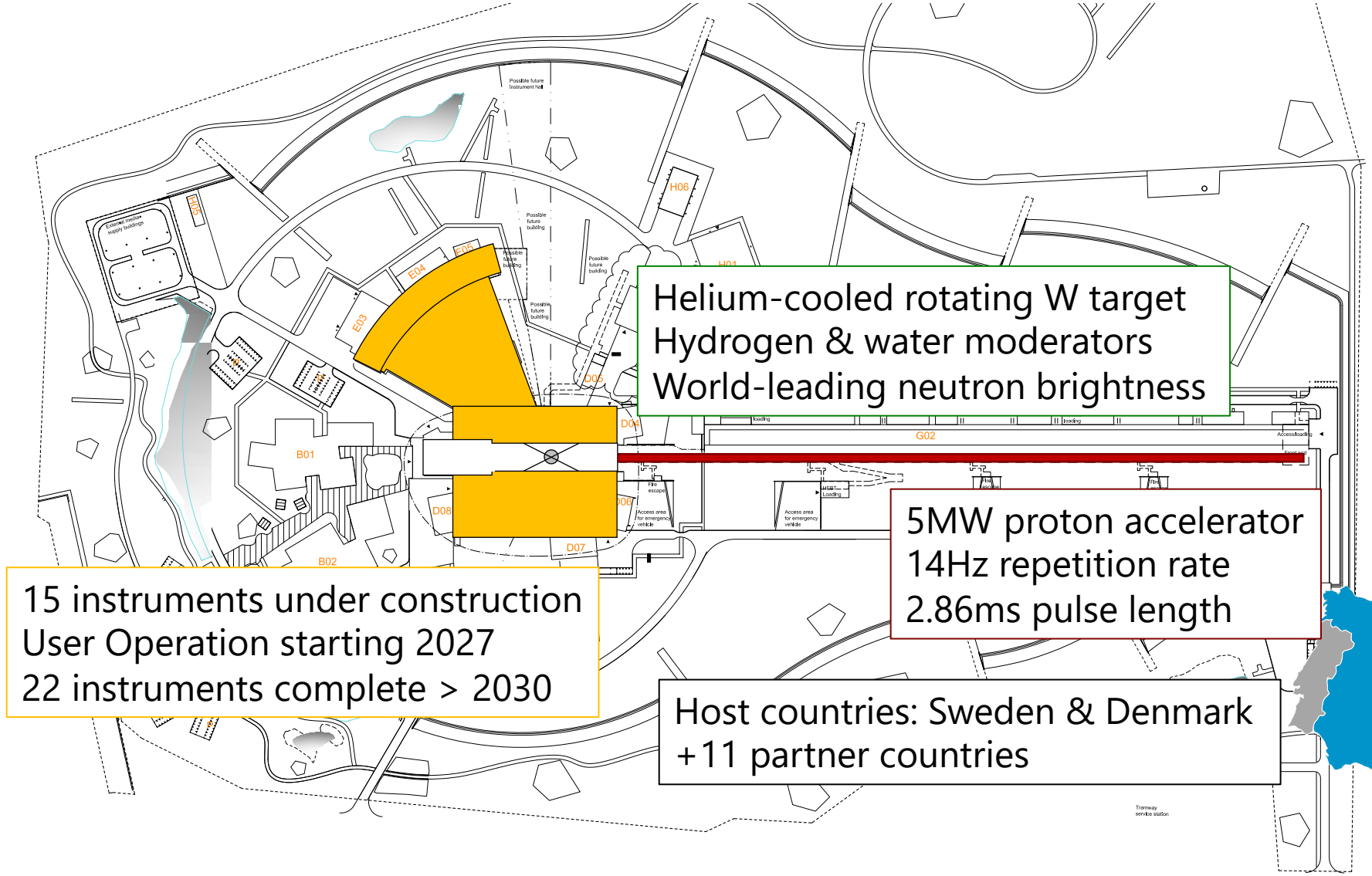
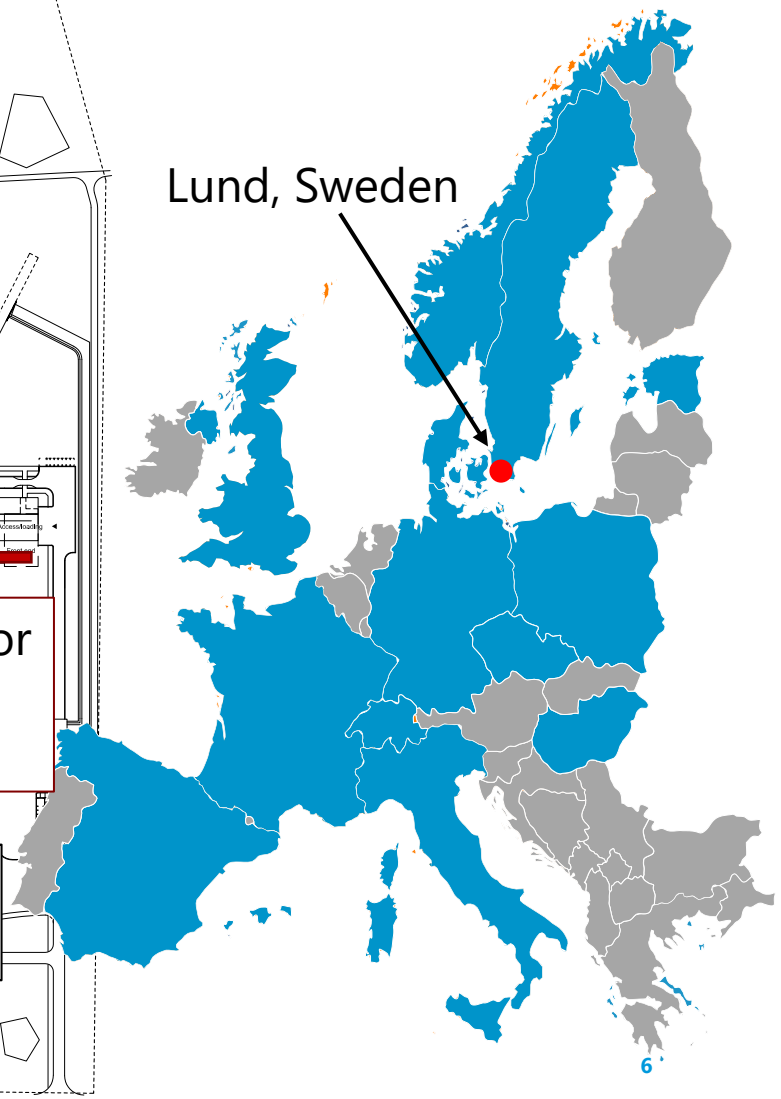




ESS: The Next-Generation Neutron Source





Project status

Time and costs update

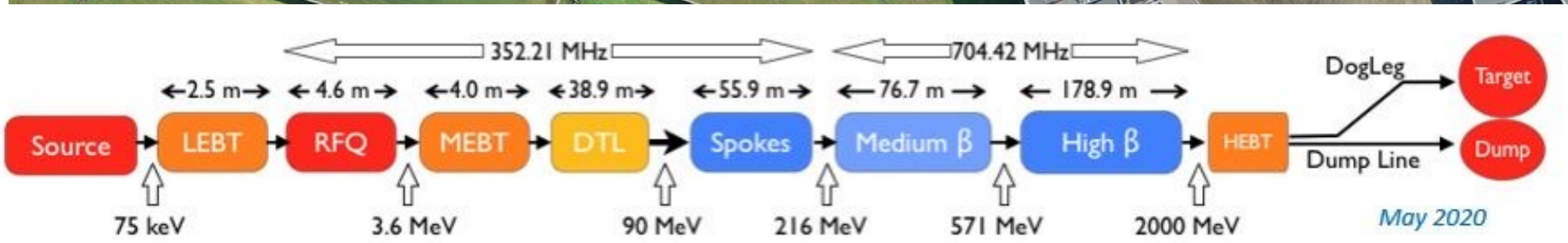
- All 23 buildings finalised 2022
  - On time in accordance with 2018 baseline
- Accumulated schedule slippage and extra costs for project as a whole
- Delays and costs caused by pandemic and technical challenges

Project rebaselined

Time and costs update

- Thorough reassessment of schedule and additional costs
- Completion at earliest possible date in most economical way
- Revised plan entails a two-year-delay
  - Full operation & open for users 2027
- The construction scope unchanged;
  - 15 instruments & 2MW accelerator

Accelerator



Accelerator commissioning achieved the next planned step

Beam through DTL-1 at design peak current

First RF pulse to the RFQ
09 June 2021

Re-establish beam to the LEBT
10 November 2021

First beam through the RFQ
26 November 2021

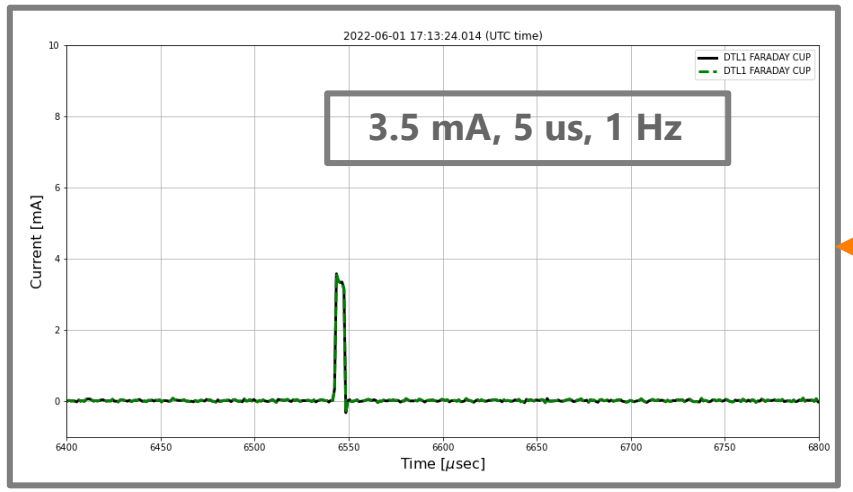
First RF pulse to DTL1
02 March 2022

First nominal current beam through the RFQ
12 March 2022

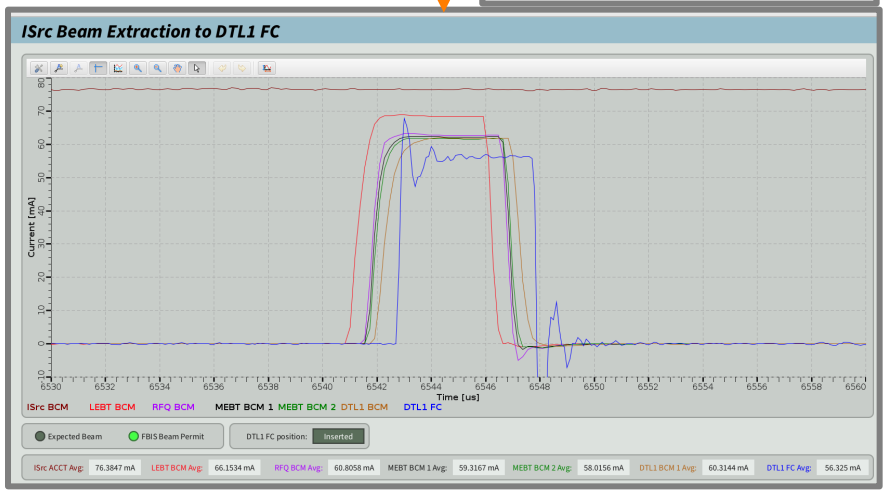
First beam through DTL1
01 June 2022

First nominal current beam through DTL1
01 July 2022

2021 Jun | Aug | Oct | Dec | 2022 Feb | Apr | Jun

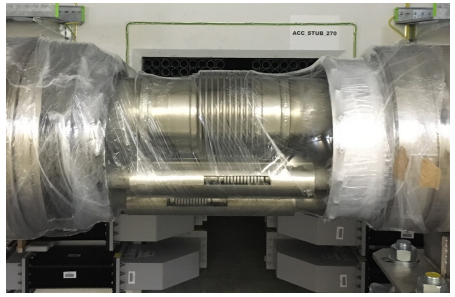


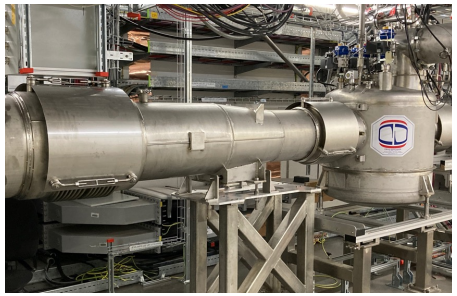
60 mA, 5 us, 1 Hz



Normal conducting part

Accelerator





The full Cryodistribution system is now installed and connected to the Accelerator Cryoplant

Testing of leak tightness and controls under way for first cool down before Christmas 2022

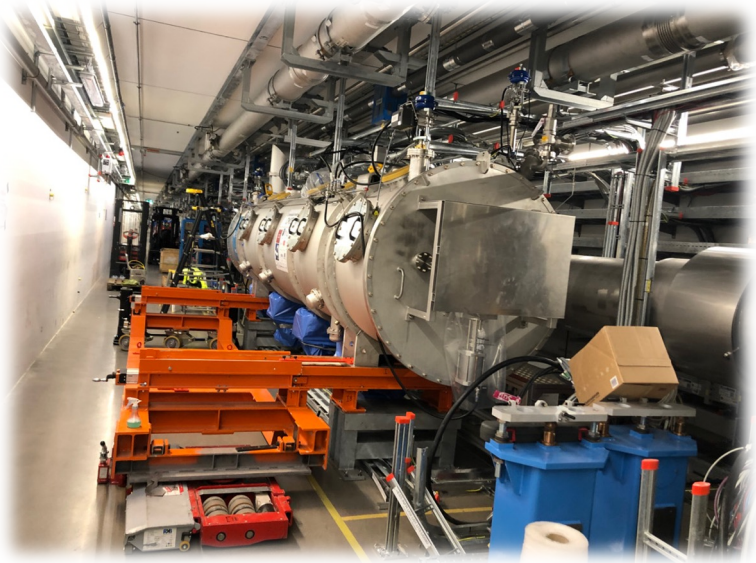
superconducting part

crymodule test installation test

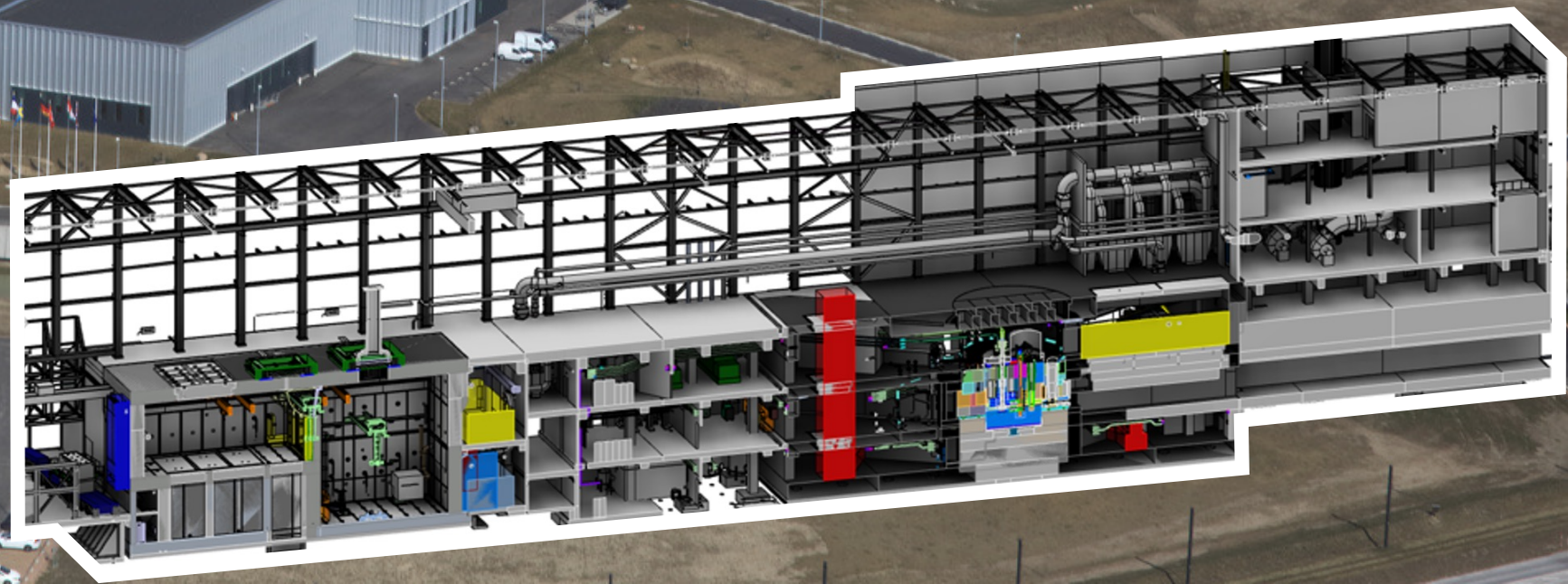
- Transport
- Alignment
- All connections
- Cabling

Lead to master installation plan

Cryomodule delivery and testing underway



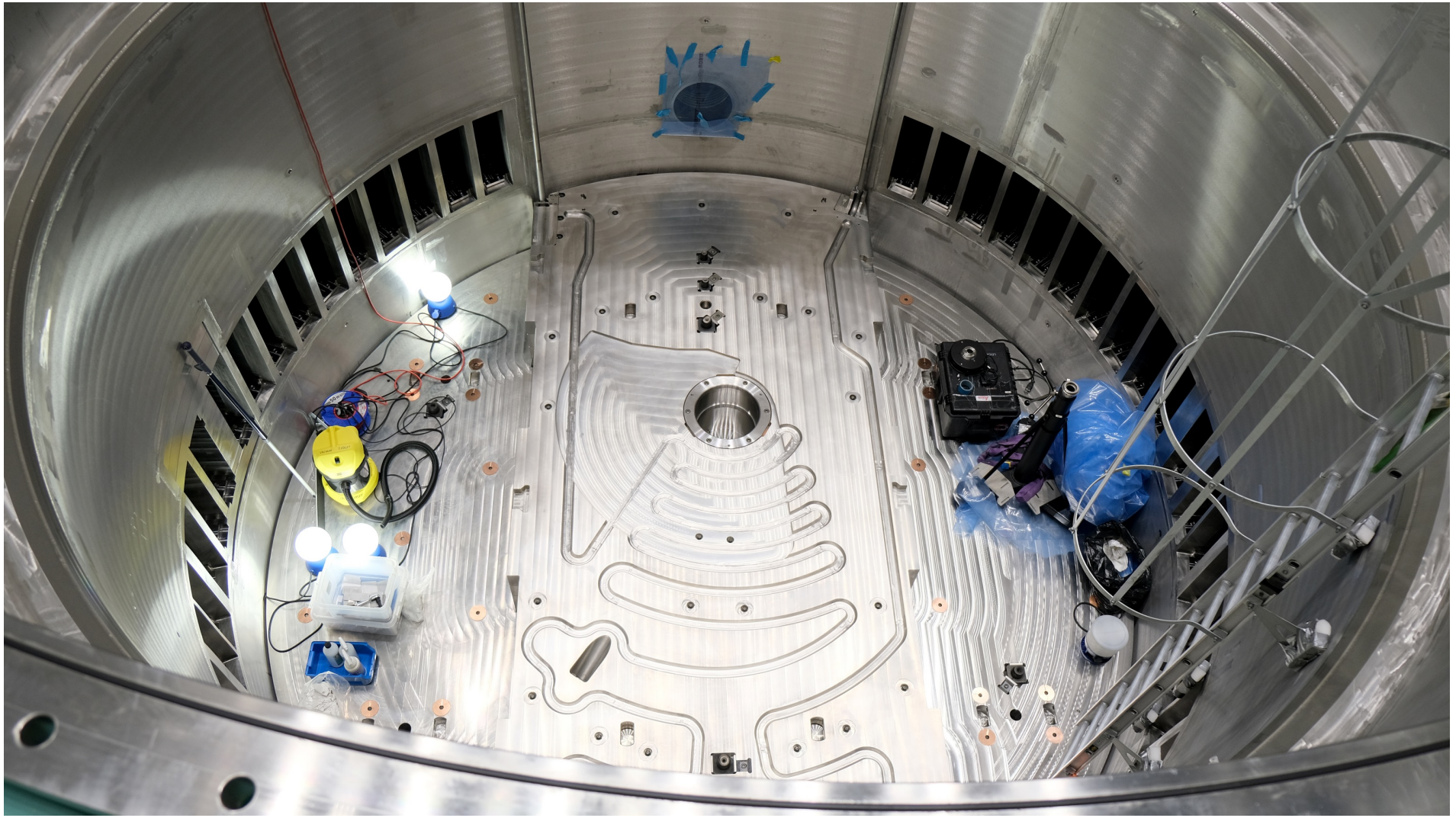
Target



Target Vessel, Target wheel

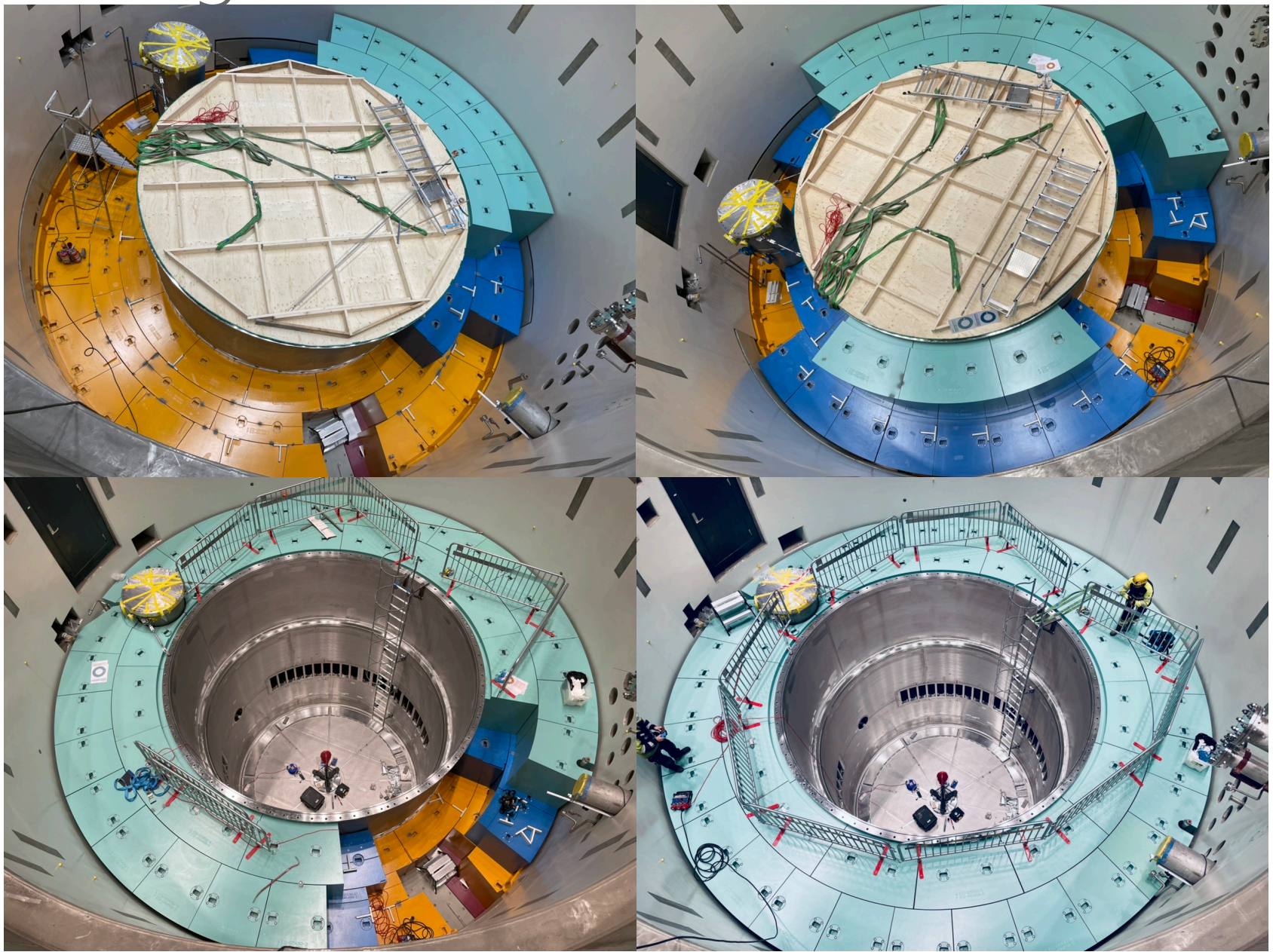
neutron beam port blocks welded to target vessel, all tests passed

Target Monolith



Several layers of the monolith inner shielding have been installed. The blocks closest to the center of the vessel have channels for the cooling-water. Seen in the middle of the picture is the so-called bucket, in which the Moderator & Reflector Plug will rest

Target Monolith



All shielding outside the monolith vessel is in place. Roughly 1700 tonnes in the form of stacked cast iron blocks.

Neutron Beam Extraction System

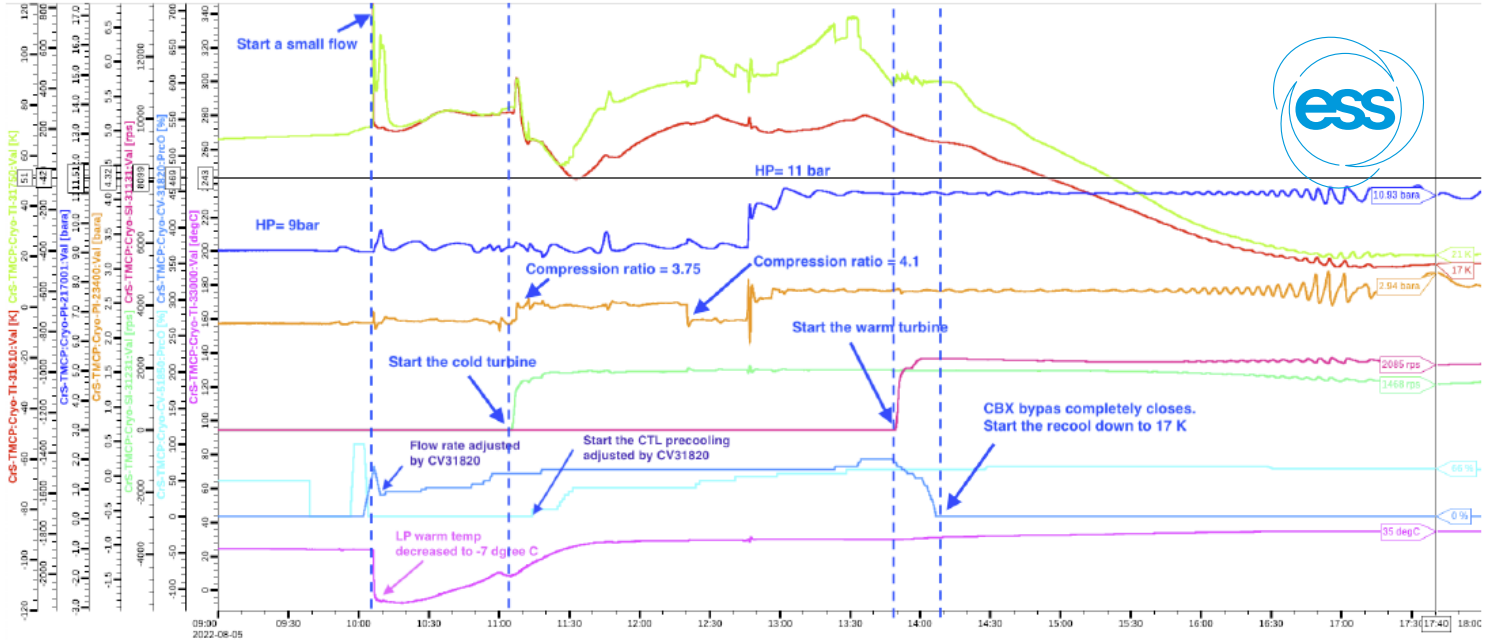
Eight Neutron Beam Port Inserts have arrived to site, TBL, LOKI, ODIN, FREIA, DREAM, ESTIA, SKADI and VESPA.

They are in different stages of being equipped with their internal Optics Assemblies

A test installation of a Neutron Beam Port Plug was successfully conducted to confirm the alignment accuracy and learn how to efficiently install the 42 items.

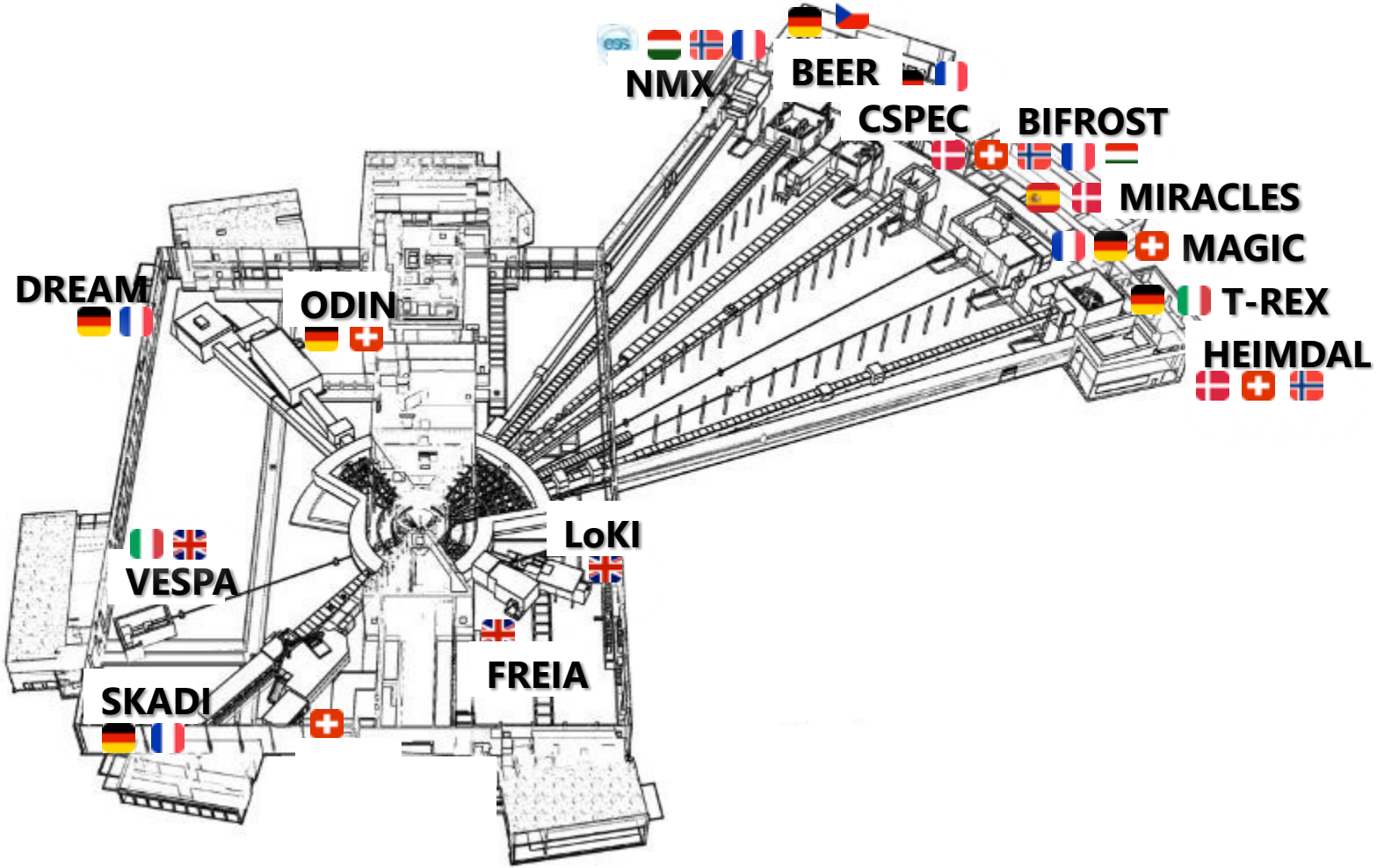
Target Systems

The moderator/reflector unit was delivered to the site. It is now awaiting the test assembly integrated with the Target Wheel in the Mock-Up and Test Stands.



The thorough testing and commissioning efforts of the Cryogenic Moderator System are ongoing. A cooldown to 17 K has been performed successfully.

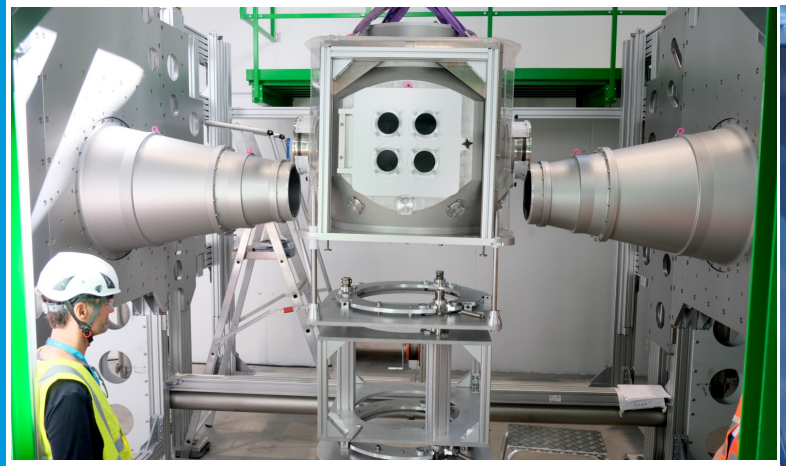
Instruments

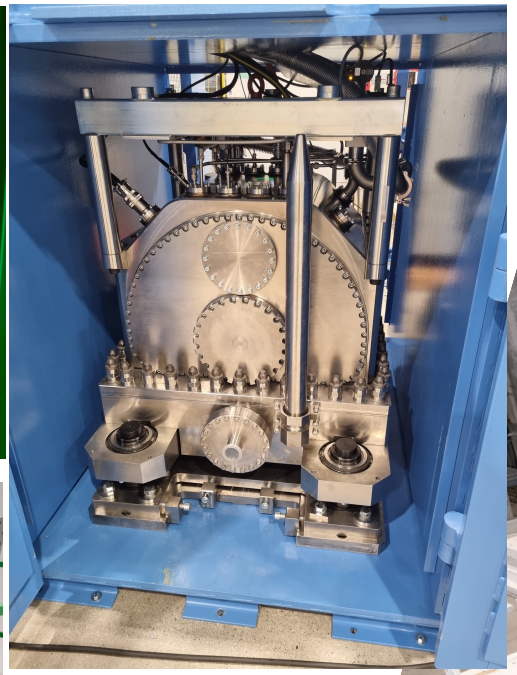


Instrument Highlights

Significant progress on site for LOKI & DREAM

LOKI: cave base done & wall elements being installed, hutch roof on-going,
DREAM: in-cave installations (Sample stage), T0 chopper SAT done





DREAM

LOKI

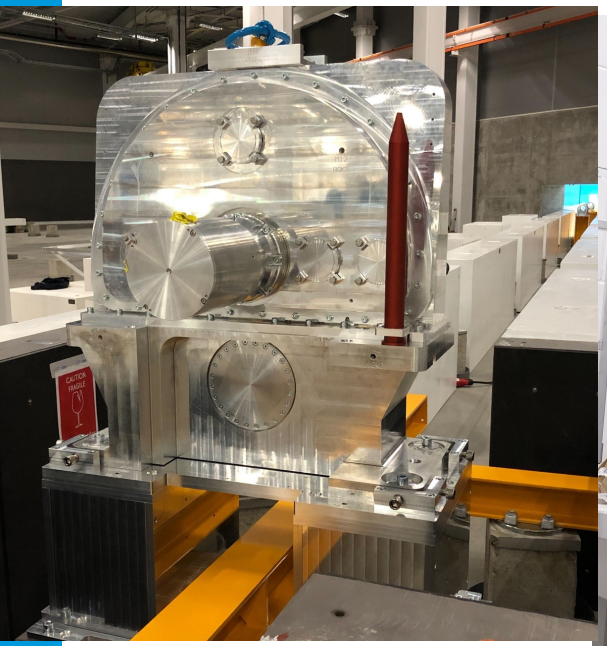
Instrument Highlights

Significant progress on site for ODIN & BIFROST

ODIN: Cave Base slab completed, delivery of walls, roof & sliding doors on-going. Hutch completed. In-bunker installations of chopper supports and guides completed.

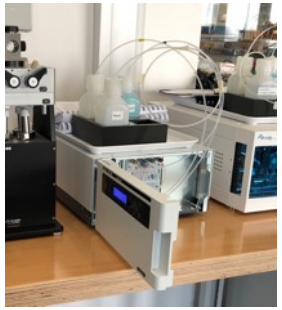
BIFROST: bandwidth chopper installed and commissioned, in-bunker guides installed, in-cave installations of sample stage and false floors

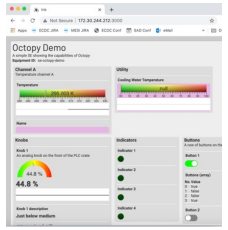
ODIN

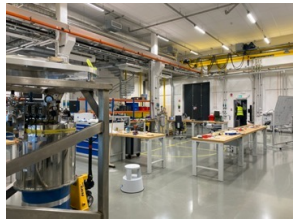


BIFROST

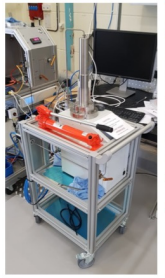
Sample Environment

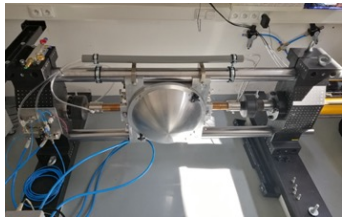






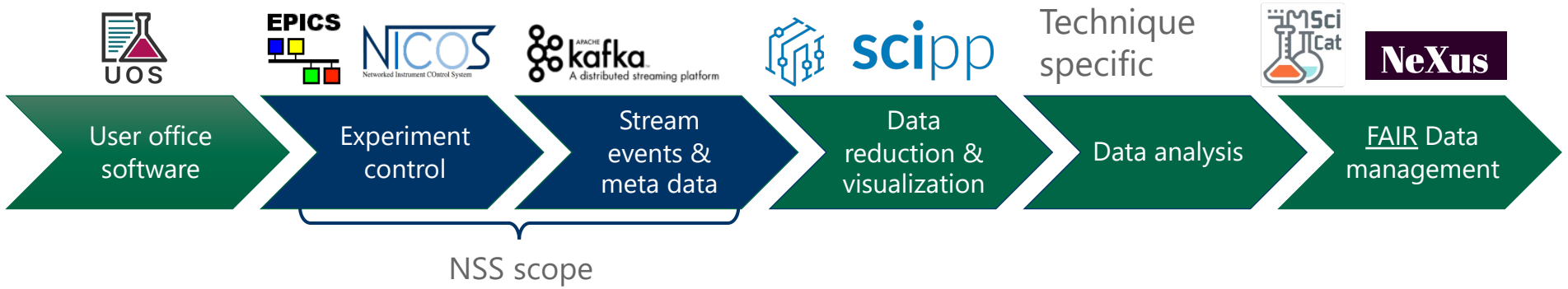
- Low Temperatures and Magnetic Fields
- High Pressure
- Mechanical Processing and High Temperatures
- Soft Matter, Surfaces and Interfaces
- Physical Chemistry
- Control Integration
- Technical Support





Data Management and Software Center (DMSC)

Scientific computing at a modern science facility



Including

- Compute infrastructure
- Remote access to compute infrastructure & services
- Live data reduction and visualization
- Live analysis for some techniques

Plus

- Support for and with instrument simulations
- User support for scientific computing (Instrument Data Scientists)
- Materials and molecular modelling and simulations (not prioritised so far)

Instrument schedule

Neutron Scattering Systems (NSS) subproject

Bunker needs to be ready for ESS BOT

NSS R-BOT has more than 6 months float to ESS BOT (May 2025)

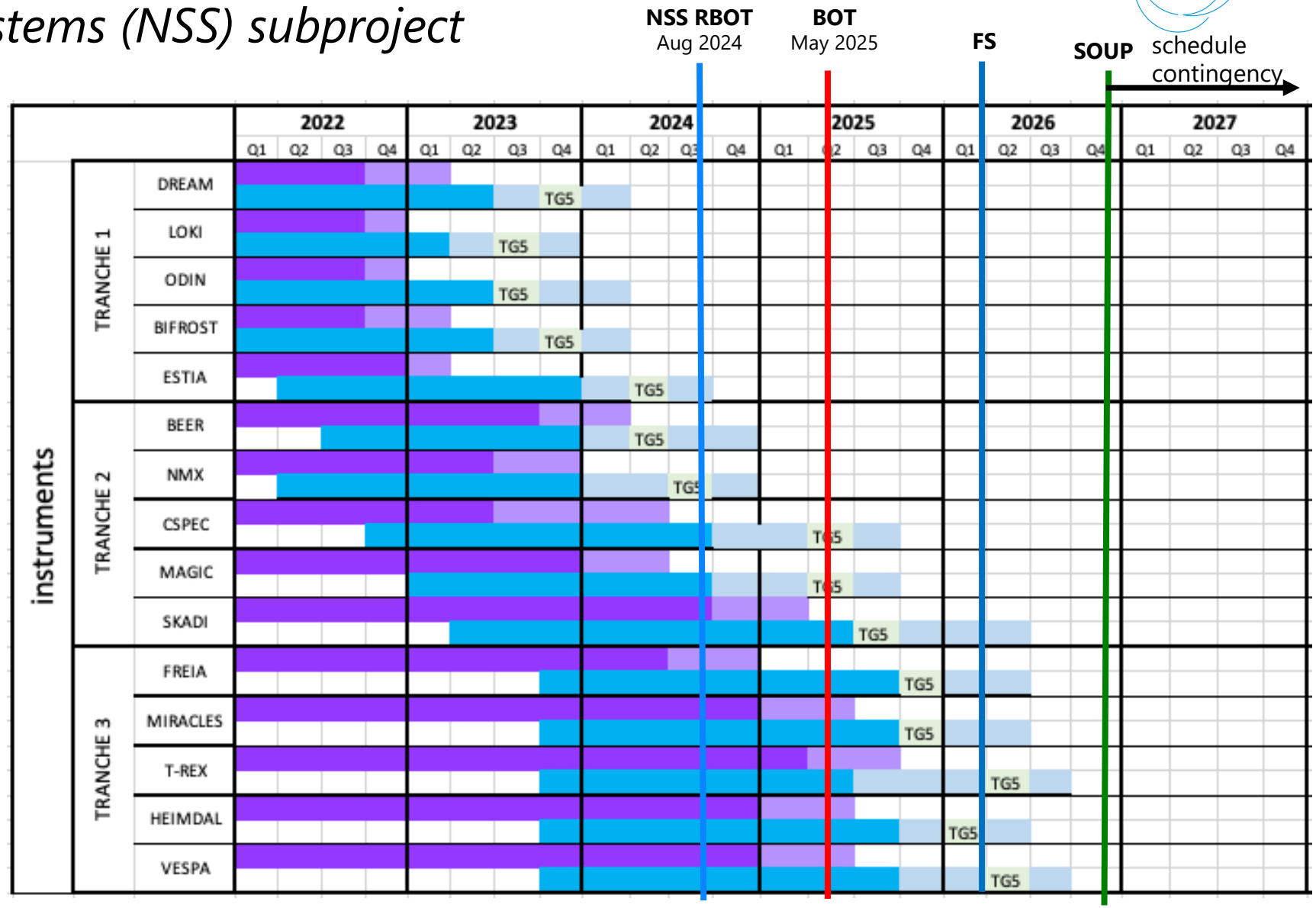
LOKI is tracking as the first instrument to be ready for HC

NSS end of project defined as Safety Readiness Review Completed for instrument 15

TG5 milestone is defined as Instrument ready for Hot Commissioning

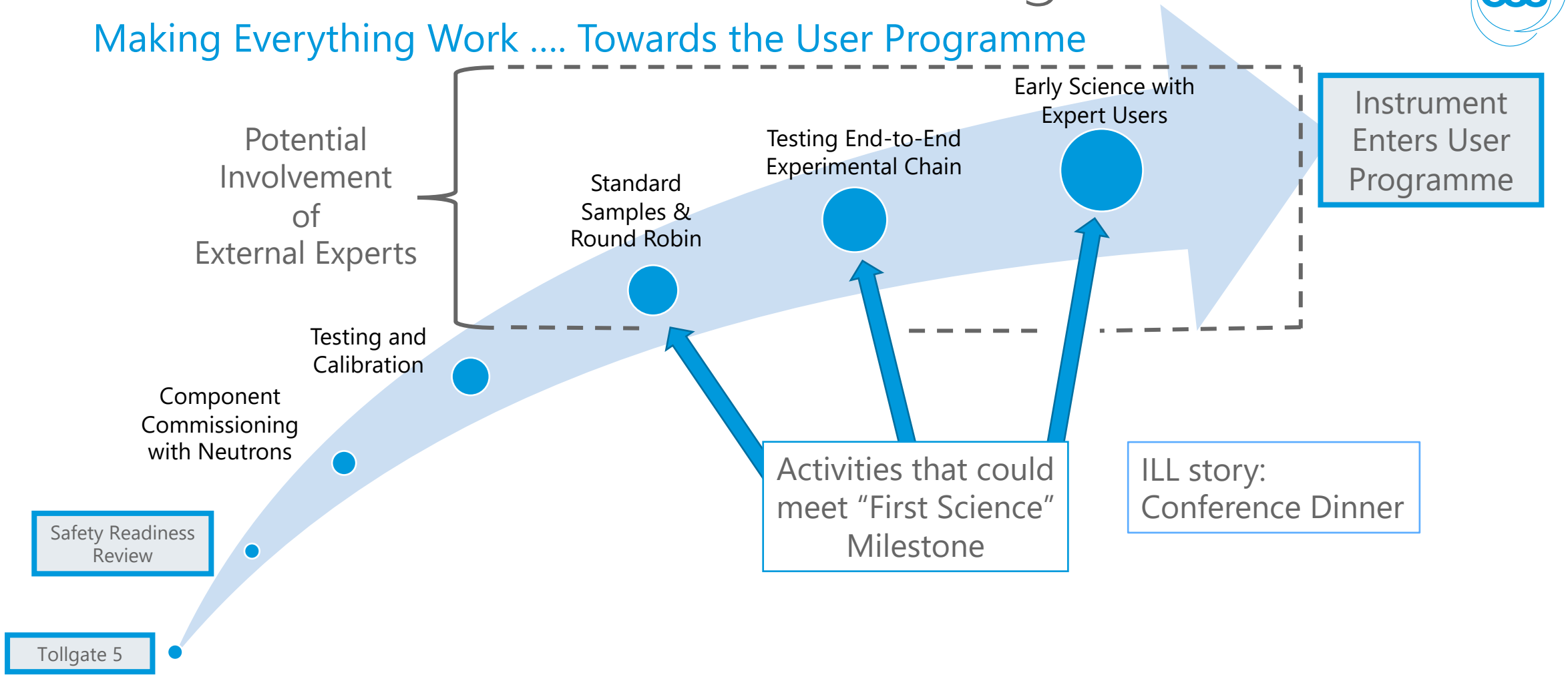
NSS is currently tracking to have 8 Instruments passed TG5 at the point of BOT, and 6 instruments passed Safety Readiness Review

The forward-looking schedule is ambitious



Instrument Hot Commissioning

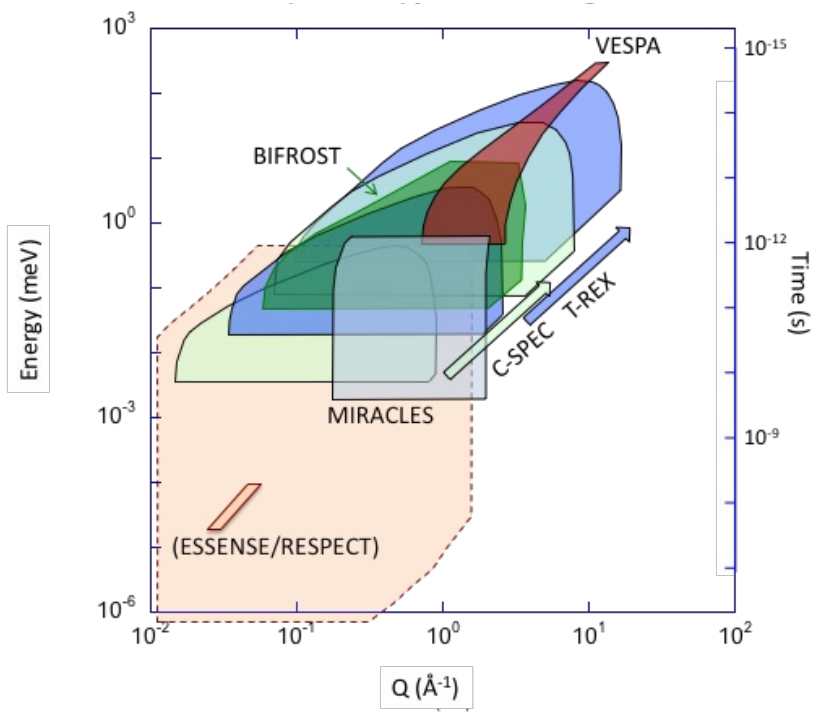
Making Everything Work …. Towards the User Programme

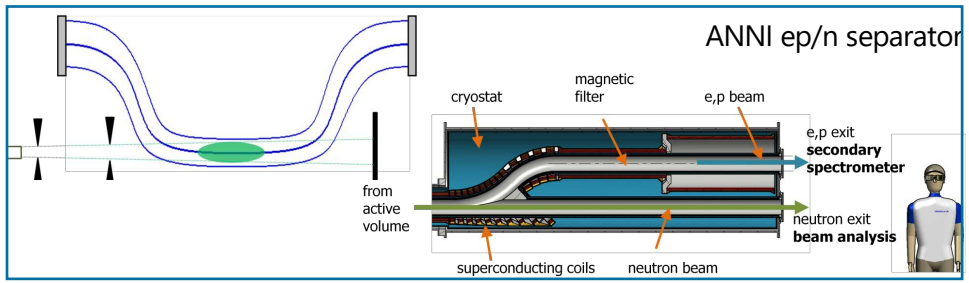


Instruments 16-22:

Capability Gap analysis published

1. High-Priority Capability Gaps
   - *Particle Physics*
   - *High-Resolution Spin-Echo*
2. Other Significant Capability Gaps
   - High Pressure Diffraction
   - Grazing-Incidence SANS
   - Very Fast Spectroscopy
   - Wide-Bandwidth Spectroscopy
   - High Magnetic Fields
3. Lower-Priority Capability Gaps
   - Bio-SANS
   - Hydrogenous-Sample Diffraction
   - Wide-Angle Spin-Echo





- https://europeanspallationsource.se/instruments/capability-gap-analysis

SCENARIOS OUTLINED IN THE 2016 ESFRI REPORT

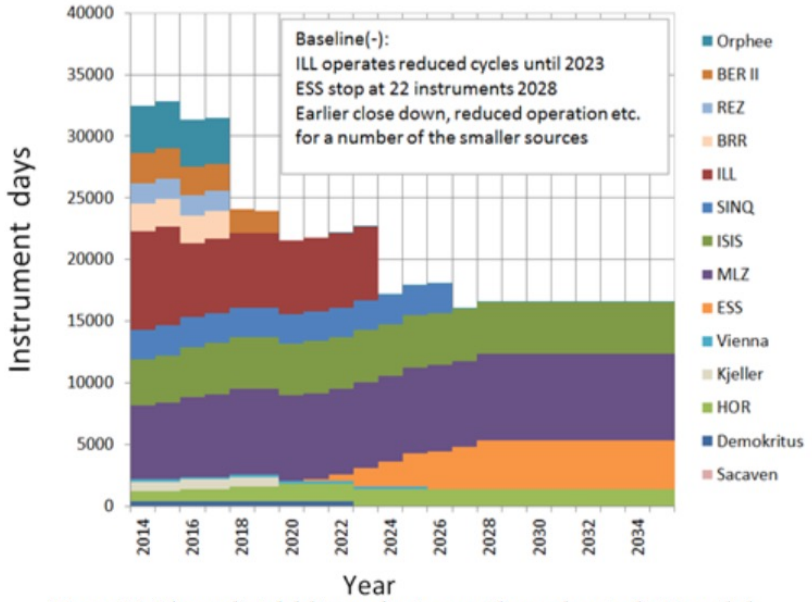


Figure 11. *The predicted delivery of instrument beam-days in the Degraded Baseline Scenario.*

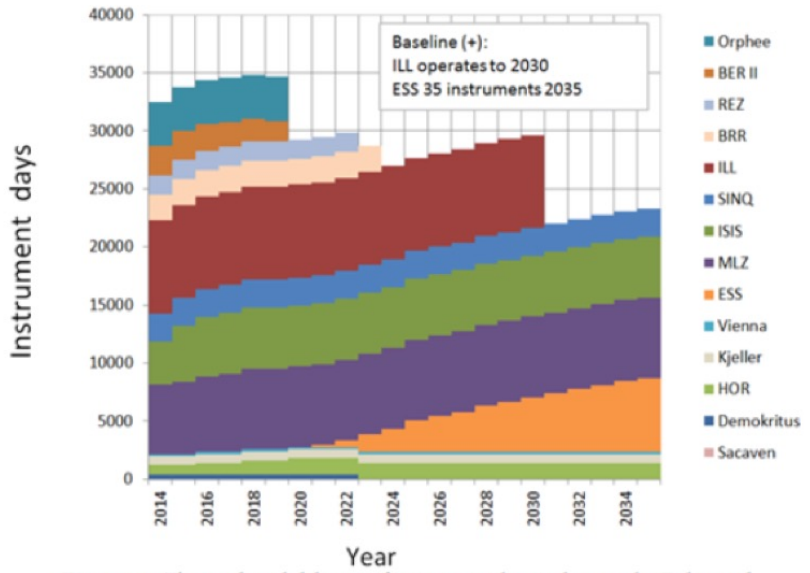


Figure 12. *The predicted delivery of instrument beam days in the Enhanced Baseline Scenario*

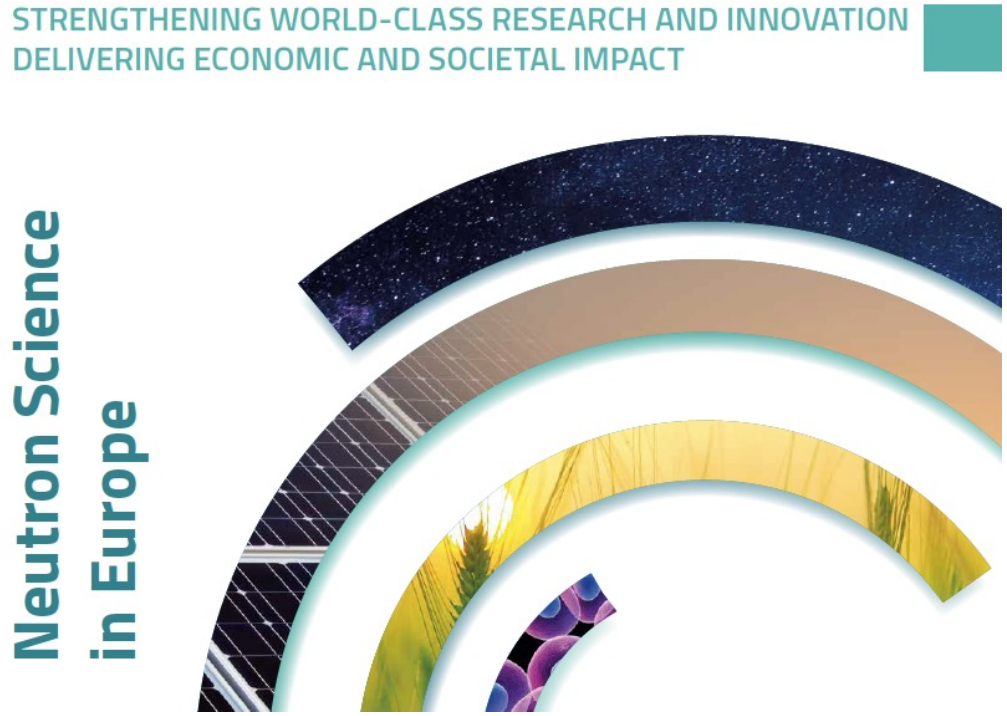
Pessimistic scenario: ILL operates at reduced output until 2023, ESS with 22 instruments beyond 2028. Earlier closer and/reduced operations for a number of medium power sources

Optimistic scenario: ILL operates until 2030, ESS with **35** instruments beyond 2035.

New LENS-BrightnESS^2 Landscape document

Collaboration with ENSA

- intended to provide a common baseline
- published on the LENS website
- hardcopy for every participant
- includes updated scenarios



Coordination of national planning and funding at the European level, with organisational and funding decisions being taken within the next few years, will be critical to ensure that Europe can maintain its world-leading role in neutron science. Opportunities beyond 2030 have been presented in chapter 3. These include

- Build-up of ESS towards full capacity and specification,
- Build-up of capacity and capability in national facilities, and
- Deploying HiCANS facilities based on the delivery of a first operating facility in the 2020's.

Published on behalf of the League of advanced European Neutron Sources (LENS) by the BrightnESS^2 project.

lens-initiative.org

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Conclusions

- Despite delays ESS has made significant progress
- Issues keep arising and are tackled
- Start of User Operation in 2027
- Visit this afternoon

➢ **ESS is a once in a lifetime chance**

➢ **The user community will make it a scientific success**