IAEA-CN301-204

The European Spallation Source Accelerator

Overview & Status

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Introduction to ESS

Scientific Goals

The goal of ESS is to provide a spallation based neutron source significantly more powerful than existing sources: 30 - 100 times brighter than ILL and 5 times more powerful than SNS

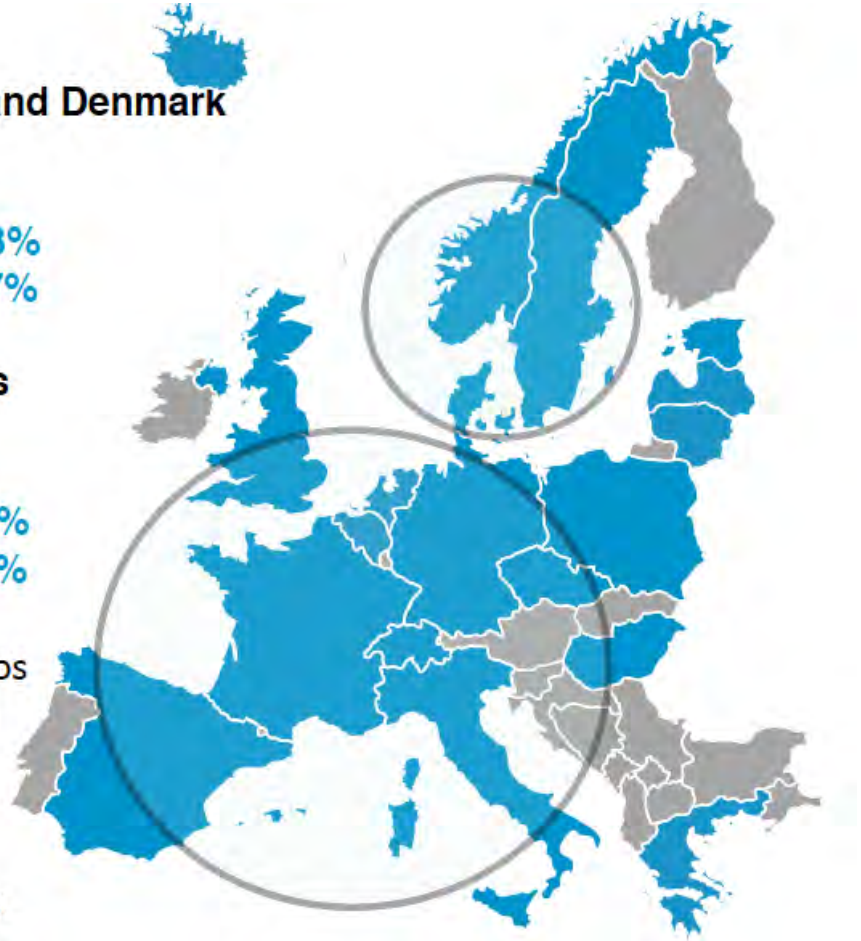
This facility will enable neutron based research in a wide range of fields including: materials science, condensed matter and biomedical studies

ESS Is a European Project
Financing includes cash and deliverables

Host Countries of Sweden and Denmark
47,5% Construction
15% Operations
In-kind Deliverables ~ 3%
Cash Investment ~ 97%

Non Host Member Countries
52,5% Construction
85% Operations
In-kind Deliverables ~ 70%
Cash Investment ~ 30%

Total Project: 1843 Million Euros
Accelerator: 519 Million Euros
Rebaseling of project
is underway

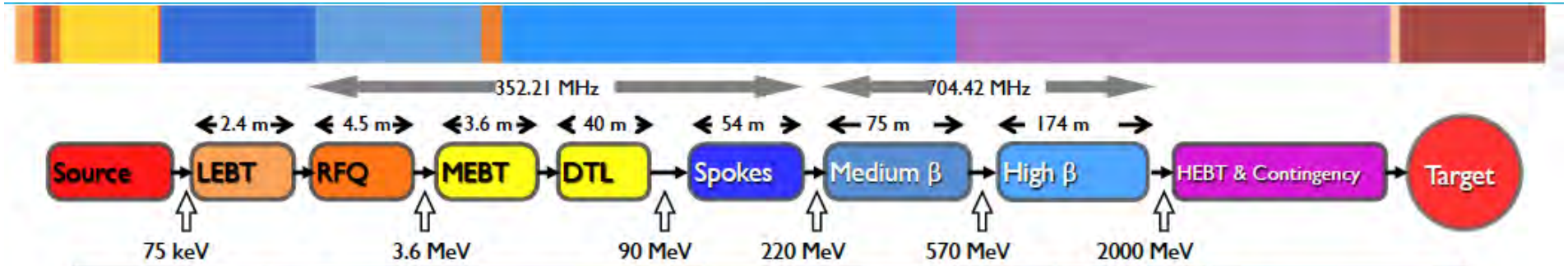


Staff from more than 50 countries are working at ESS

ESS Design

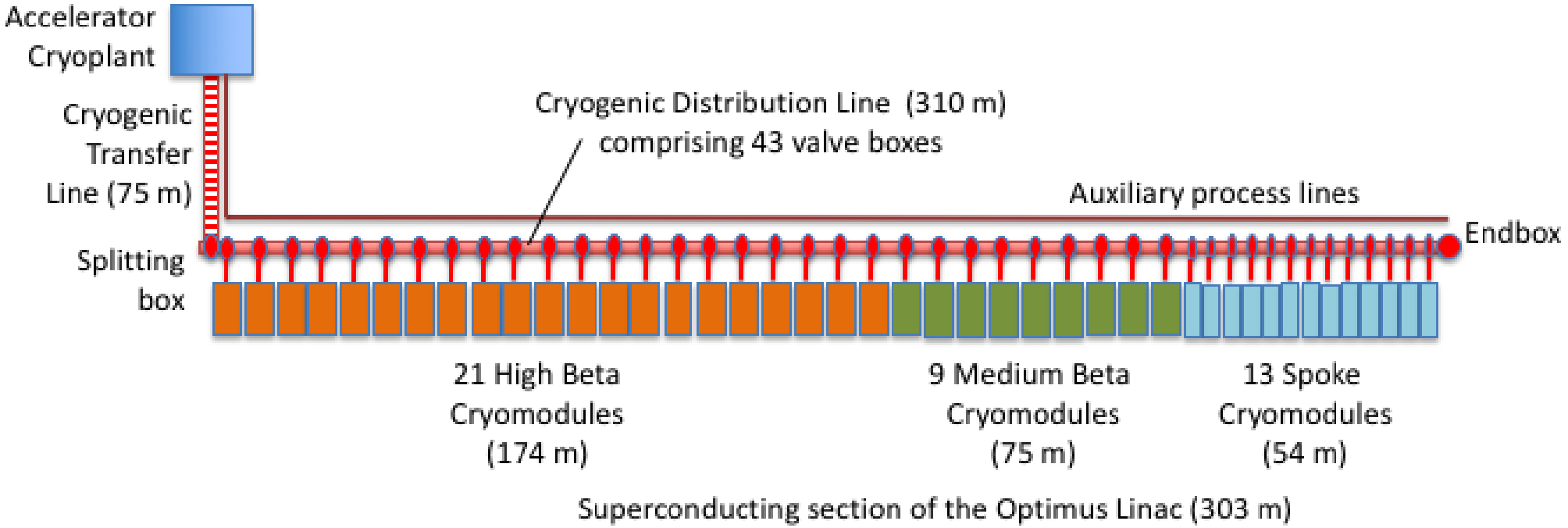

High Power
Linear Accelerator:
• Energy: 2 GeV
• Rep. Rate: 14 Hz
• Current: 62.5 mA
Target Station:
• He-gas cooled rotating W-target (5MW average power)
• 42 beam ports
Ion Source
15 Instruments in Construction budget
Committed to deliver 22 instruments
Peak flux ~30-100 brighter than the ILL
Courtesy A. Heiss

ESS Linac



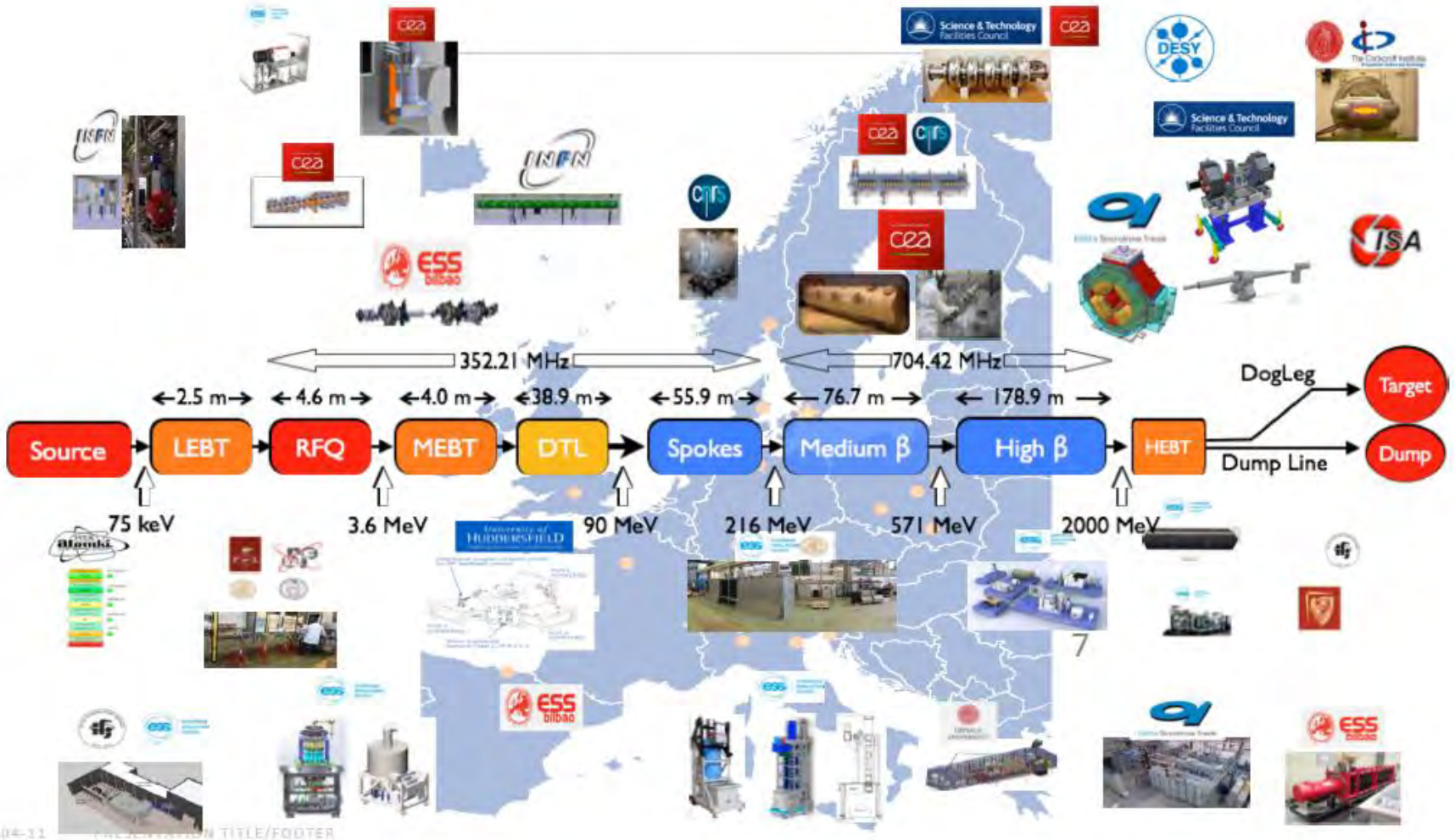
	Energy (MeV)	No. of Modules	No. of Cavities	βg	Temp (K)	Cryo Length (m)
Source	0.075	1	0	–	~300	–
LEBT	0.075	–	0	–	~300	–
RFQ	3.6	1	1	–	~300	–
MEBT	3.6	–	3	–	~300	–
DTL	90	5	5	–	~300	–
Spoke	220	13	2 (2S) × 13	0.5 β_{opt}	~2	4.14
Medium β	570	9	4 (6C) × 9	0.67	~2	8.28
High β	2000	21	4 (5C) × 21	0.86	~2	8.28
HEBT	2000	–	0	–	~300	–

The ESS Accelerator Cryogenic System



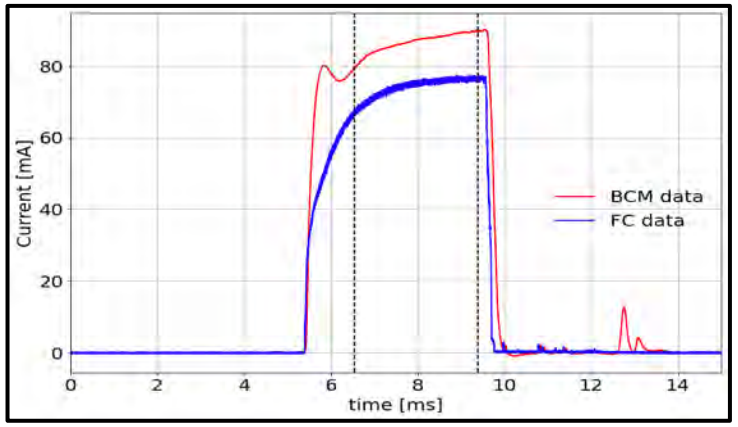
Accelerator Collaboration

Nearly all the technical systems in the accelerator tunnel are provided by In-Kind partners

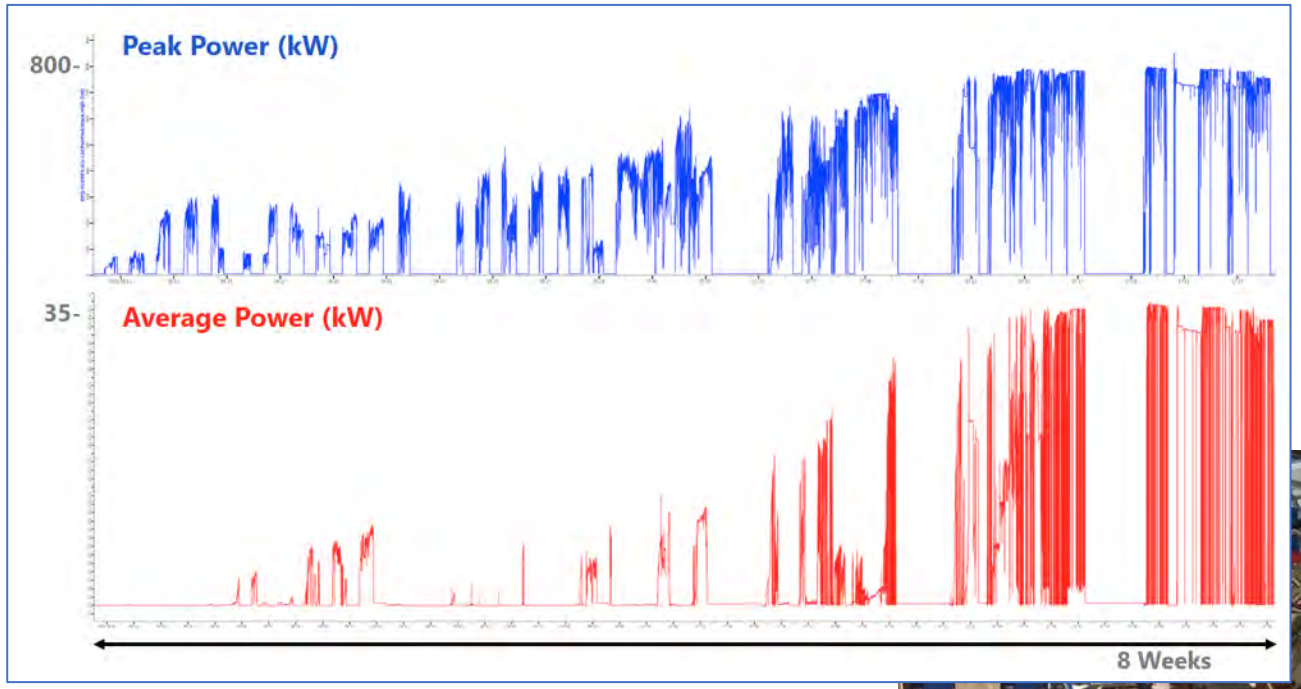


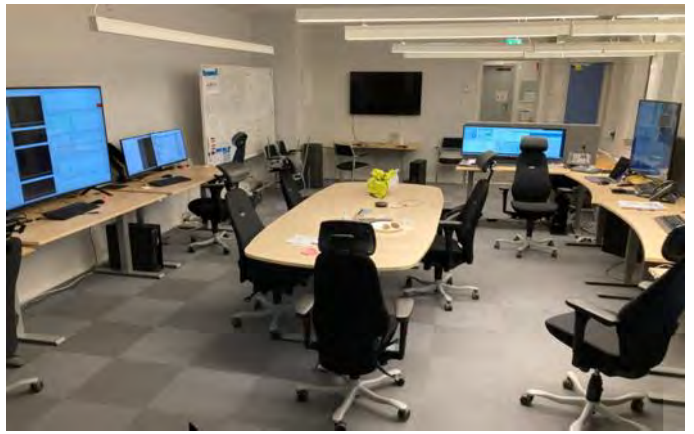
Ion Source and Low energy Beam transport for ESS!

- **First IK delivery for accelerator and First Beam at ESS**



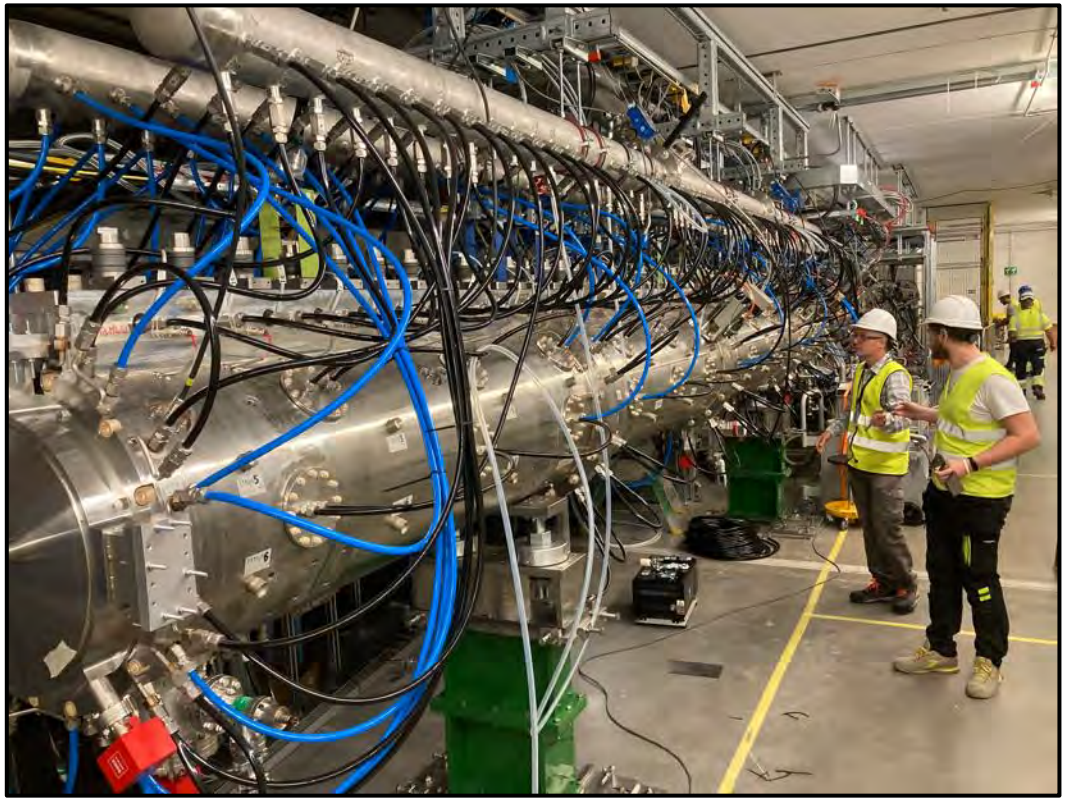
Radio Frequency Quadrupole conditioned and initial beam commissioning has been completed

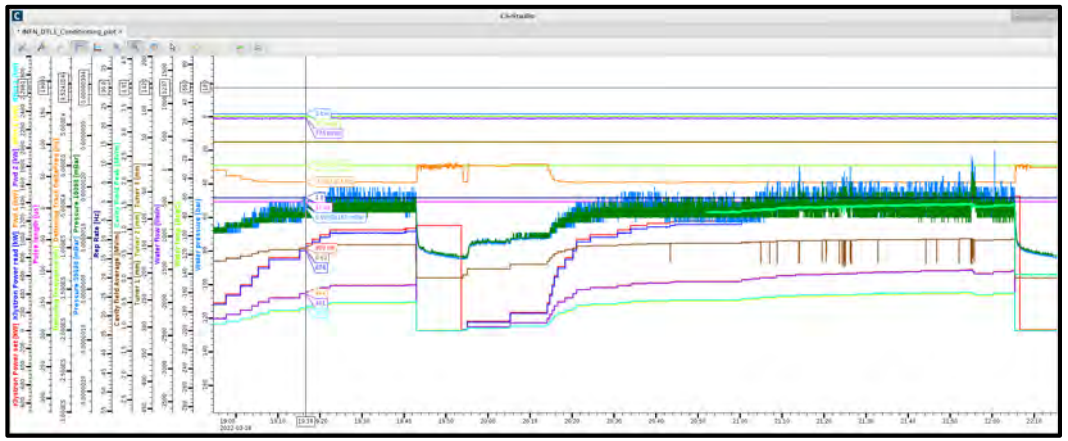




Drift Tube LINAC

Start of DTL1 Conditioning





DTL1 RF Conditioning under way!

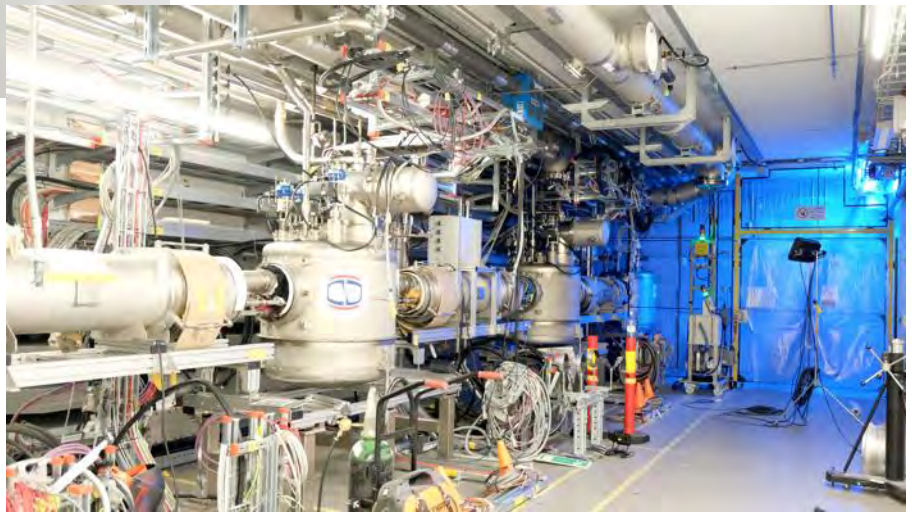
Spoke CMs and elliptical CMS arriving at ESS

- Seven spoke CMS have been tested in Uppsala and have been delivered to ESS
- Five Elliptical MB CMs have arrived at ESS, three are tested at ESS

All Linac Warm Units are Completed

Installation in Tunnel has Begun

Progress in tunnel for Cryodistribution and magnets



- All parts of spoke LINAC cryogenic distribution system delivered and installed
- Cool-down planned for Q3 2022

The Accelerator Cryoplant is Fully Commissioned

Sustainability

An Early Commitment

- From the beginning, a commitment of ESS was sustainability. This takes a number of forms including:
- Use of sustainable energy
- Heat recovery
- Energy efficiency (i.e. don't use the power in the first place)
- This commitment meant that from the start of the project, funding was available to reduce energy use and operating costs even if that meant higher initial capital costs.
- For example in the procurement of large Accelerator Cryoplant, the bid evaluation criteria weighed equally operating costs and capital costs, thus a vendor could win with a more expensive bid if the proposed plant had lower operating costs (i.e. saved energy)

Energy Recovery at ESS

- A high level goal of ESS is to recover 50% of the energy used on the site over the lifetime of the facility. Heat is recovered from RF systems such as klystrons, target cooling systems, cryogenic systems and others.
- The recovered heat will be used to heat facility buildings and be deposited into the District Hot Water system.
  - Note that there are no cooling towers or cooling ponds at ESS. Our heat sink is the District Hot Water system.
- In the ESS cryogenics system, heat is mainly recovered from the oil and gas coolers of the Accelerator Cryoplant and Target Moderator Cryoplant. A minor part is recovered from compressor motors and turboexpanders.
  - The maximum heat recovered from the cryogenics system is expected to be 4.5 MW out of a total power usage of 5.1 MW

Summary

- The ESS will be a world class neutron source permitting innovative research in materials science, chemistry, biology, biomedical science etc.
- The accelerator is well advanced with first beam on target scheduled for 2024 and first science scheduled for 2027.
- ESS is built with significant in-kind contributions. This approach will be seen more and more in future large projects.
- Sustainability is an important goal and has been built into the design from the start of the project.

Thank you

The authors wish to thank the entire ESS and In-Kind team for their contributions to the project