

Welding in Big Science

Praktisk svetsning inom forskningsvärlden

Björn Rundcrantz

K-utveckling Engineering AB

Energy



- ▶ Transmission and distribution
- ▶ Renewable energy
- ▶ Nuclear

Science



- ▶ Neutron facilities
- ▶ Light sources
- ▶ European research facilities

Industry



- ▶ Paper and pulp
- ▶ KLT wood production

K-utveckling engineering's core business is...

Projects - a process and a platform for result

We have experienced personnel with specific and relevant knowledge.

We work in all phases of a project.

We can manage and work in complex projects.

We are specialized in large and medium sized projects.

We can participate both on the customer's side as well as on the supplier's side.

Björn Rundcrantz

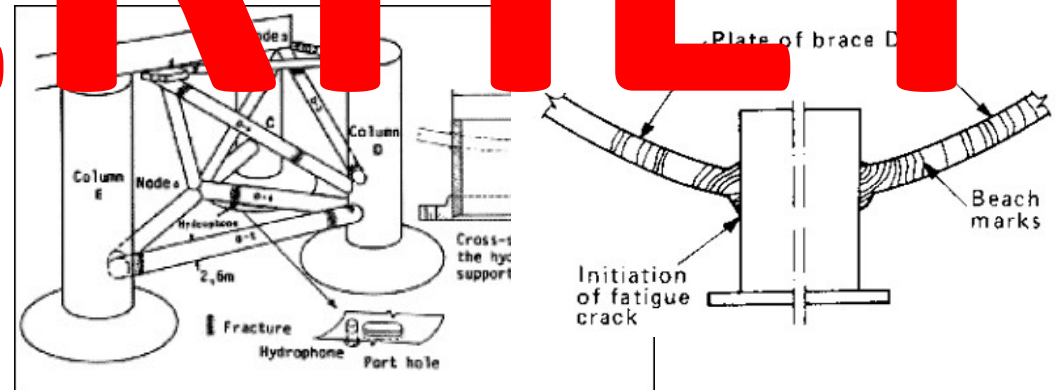
Senior Welding & Quality Engineer

+46 70 625 57 35

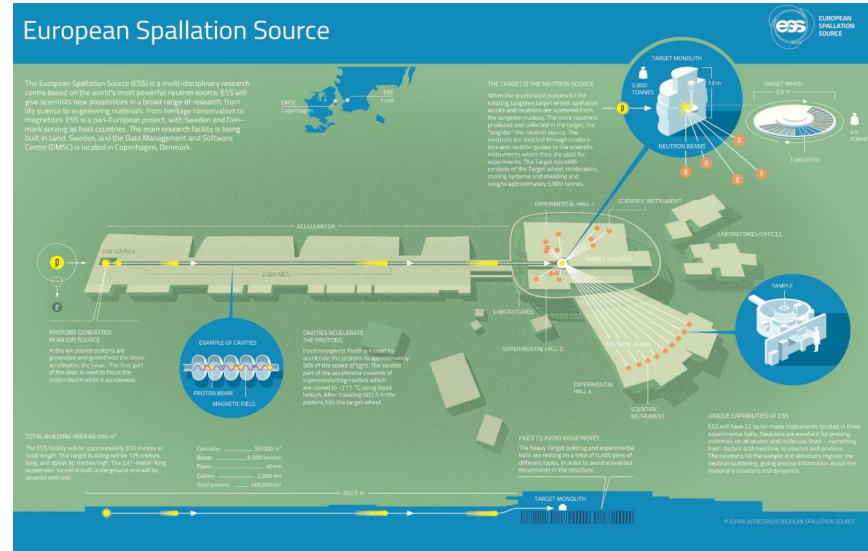
bjorn.rundcrantz@kutveckling.se

Varför krav på svetsning?

SÄKERHET



Kvalitet vs. kostnader



Konsekvenser



Ariane 6
 Projektkostnad: €3,6B
 Uppskjutningskostnad: €75-90M

European Spallation Source (ESS)

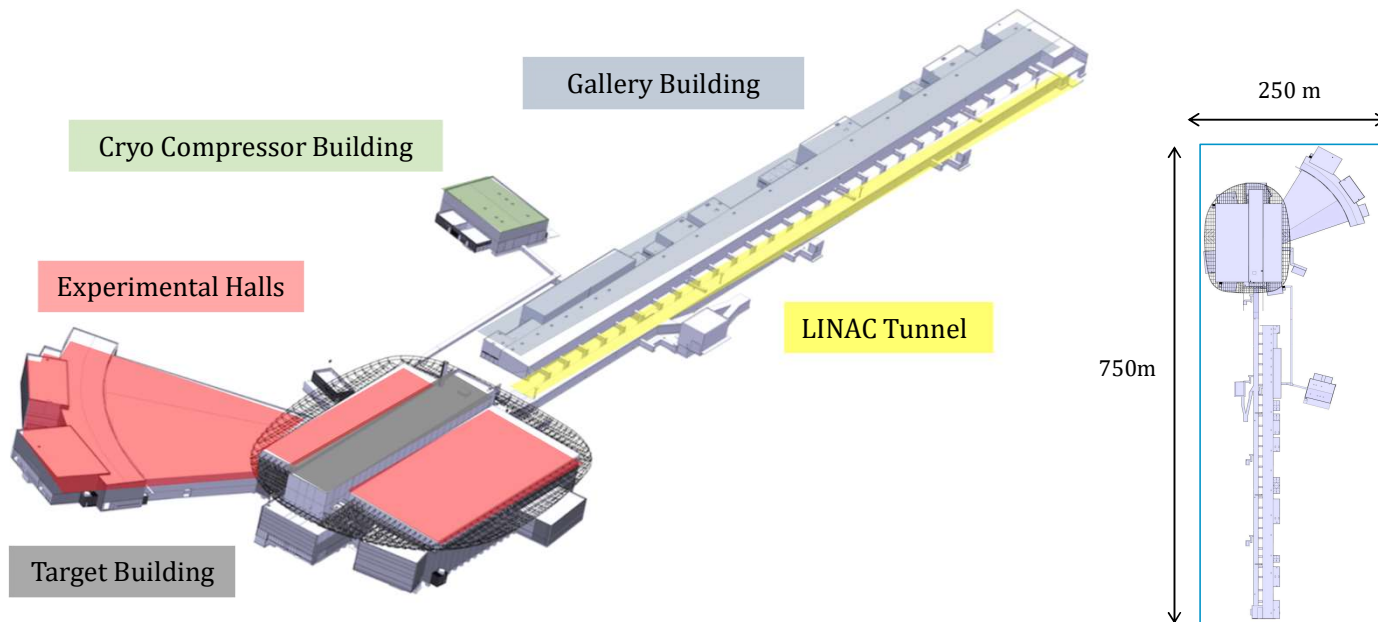


Mars 2013

The first ESS flag was planted on site in March 2013.
Per Nyberg/ESS



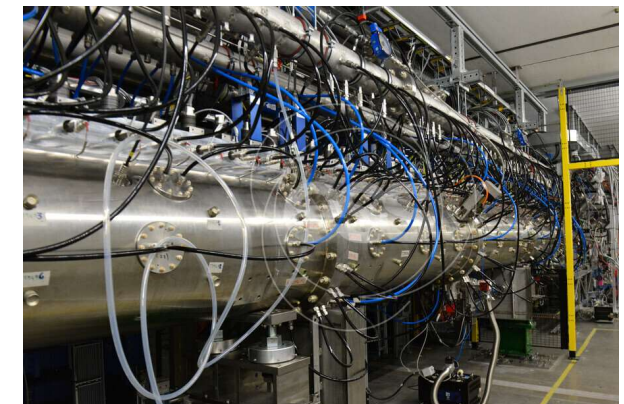
April 2021



ESS

Budget: €3,5B

- Effekt 5 MW
- Tillgänglighet >95%
- Rörsystem >100 km
 - $\text{Ø}6,0 \times 1,0$ – DN500
- >15000 ventiler



ESS DTL tuber

Kvalitet – Defekter



Rotvulst



“Kontaminering”



Svetsreparationer



Oxidering



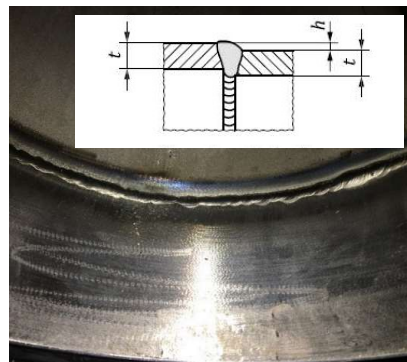
“Svamp”



Ofullständigt inträngning



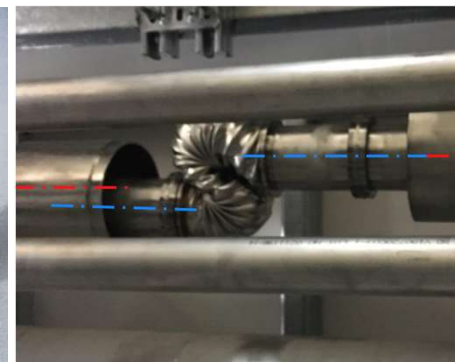
“Kontaminering”



Kantförskjutning



Skador



Konstruktion

”Rent system”

Exempel

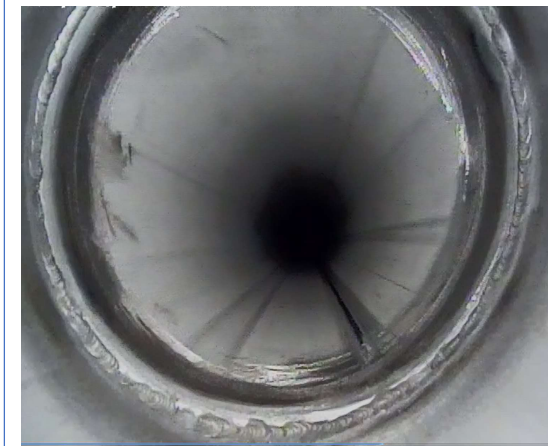
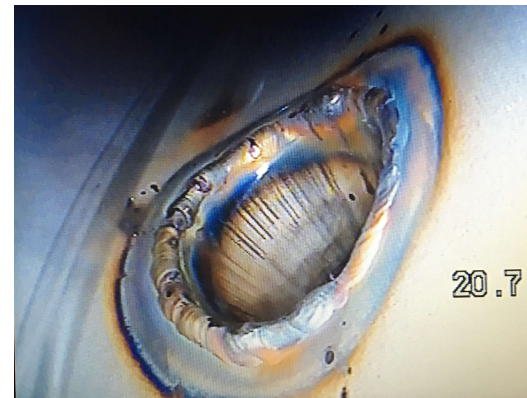
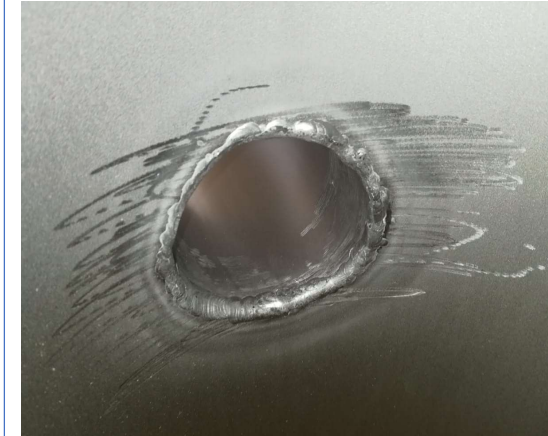
- DN150
- 2 x ~500 m. kylvattenrör

Åtgärd

- Rengöring & Spolning
- Betning
- Spolning & Passivering
- Inspektion

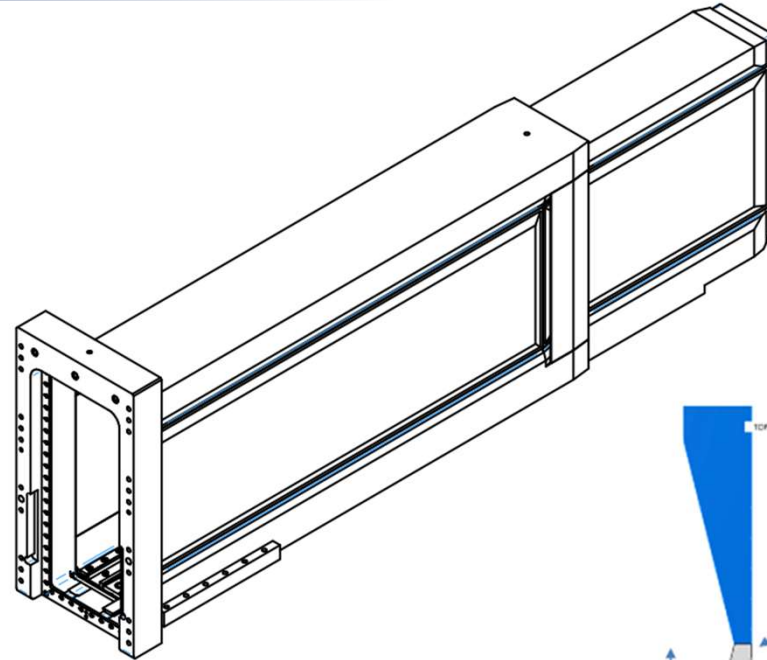
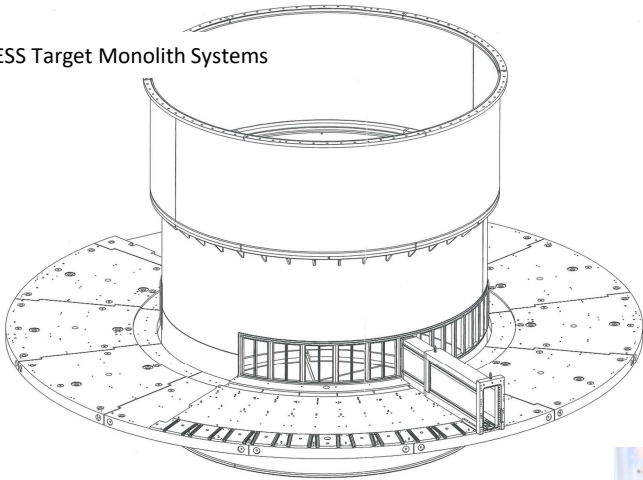


- Efter åtgärd

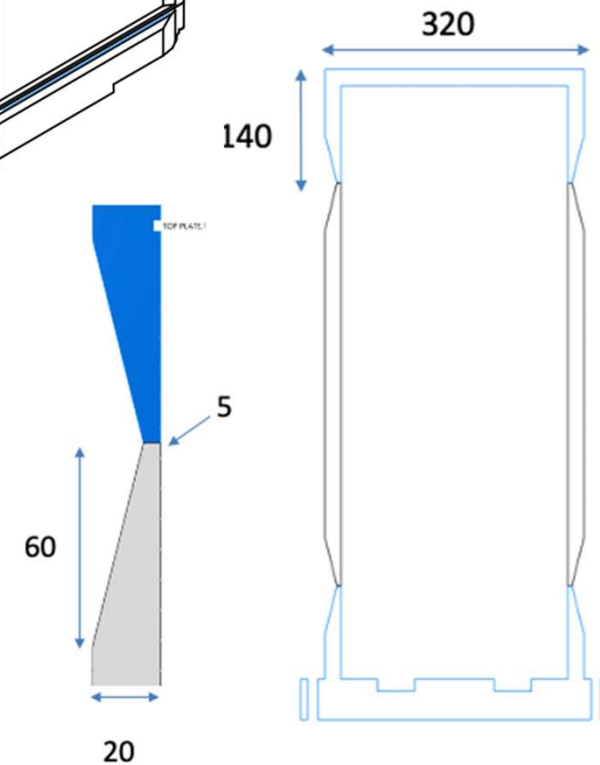


Tillverkning port-tuber / Installation

ESS Target Monolith Systems



▪ 39 Port-tuber



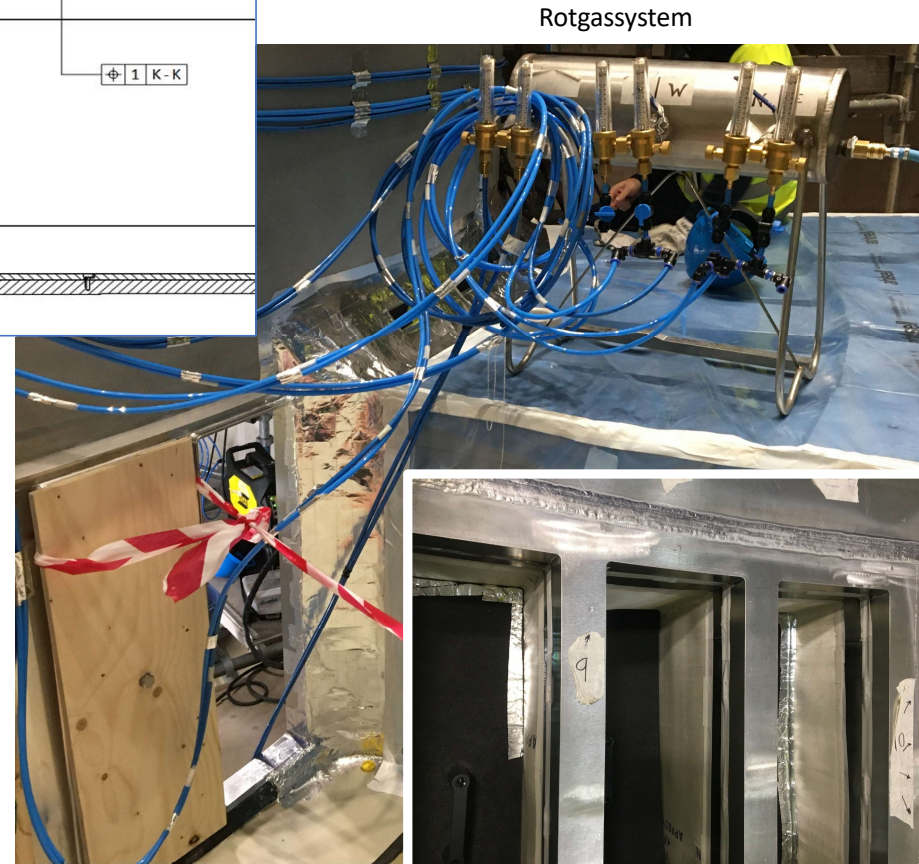
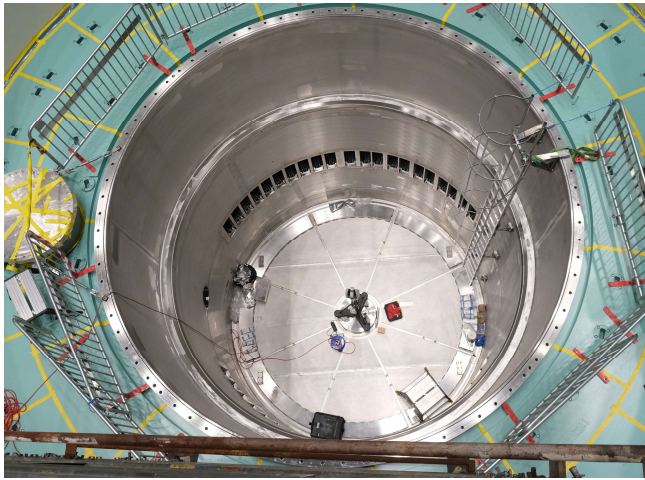
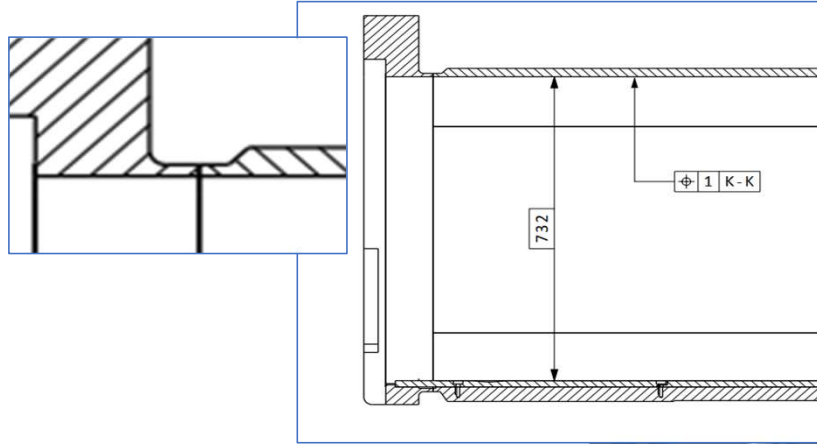
Tillverkning ENSA

- Höga toleranskrav
- Svetsmetod - LAW
- Minimerad svetsvolym
- Åtkomlighet OFP

Tillverkning port-tuber / Installation

Svetskrympning

- 0,6-0,8 mm



A (light) – C (darkest)	B (light) – B (darkest)	C (light) – D (darkest)	D (light) – E (blue)
<2 ppm O ₂	25 ppm O ₂	50 ppm O ₂	100 ppm O ₂
Purge gas type. Argon EXTRACT FROM FORCE TECHNOLOGY Report 1337-3-en FOR ILLUSTRATION PUPOSES ONLY			

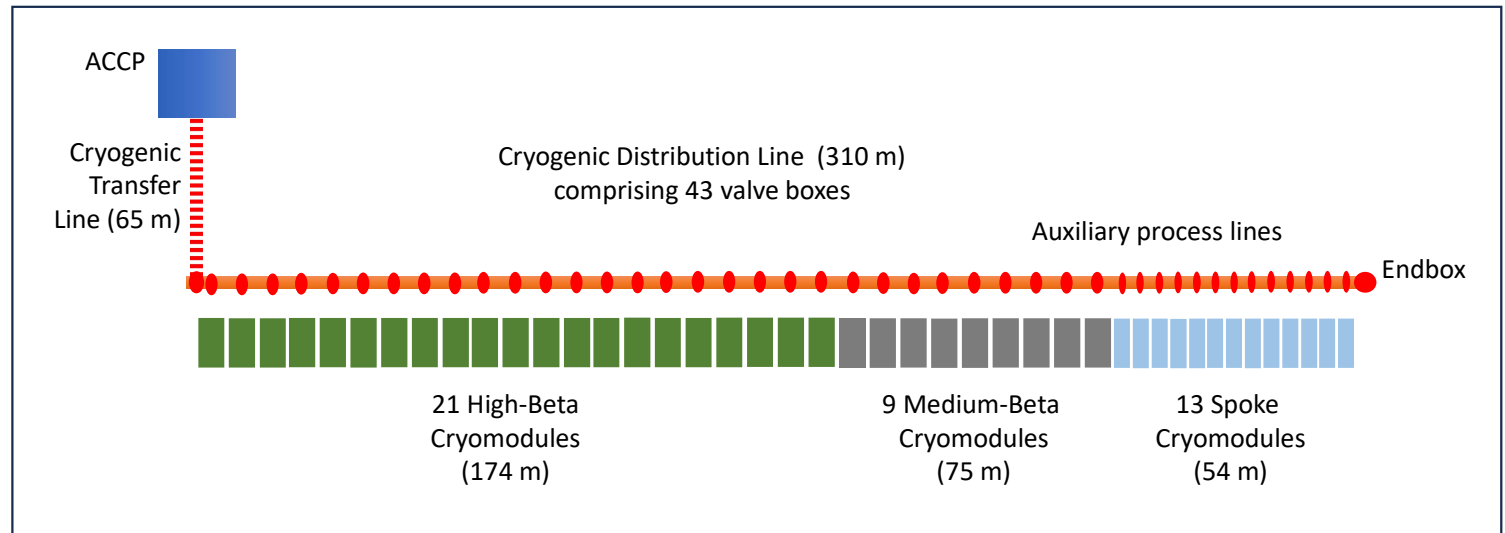
ESS Cryogenic Distribution System (CDS)

ESS Cryogenic Distribution System (CDS)

- superkritisk helium, temperatur < 5.2 K
- vacuum $< 10^{-6}$ mbar
- helium läckage $< 1 \cdot 10^{-7}$ mbar·l/sek.
- täthet ventilsäte, $\leq 1 \cdot 10^{-4}$ mbar·l/sek.
- 200 termiska cykler

Normkrav

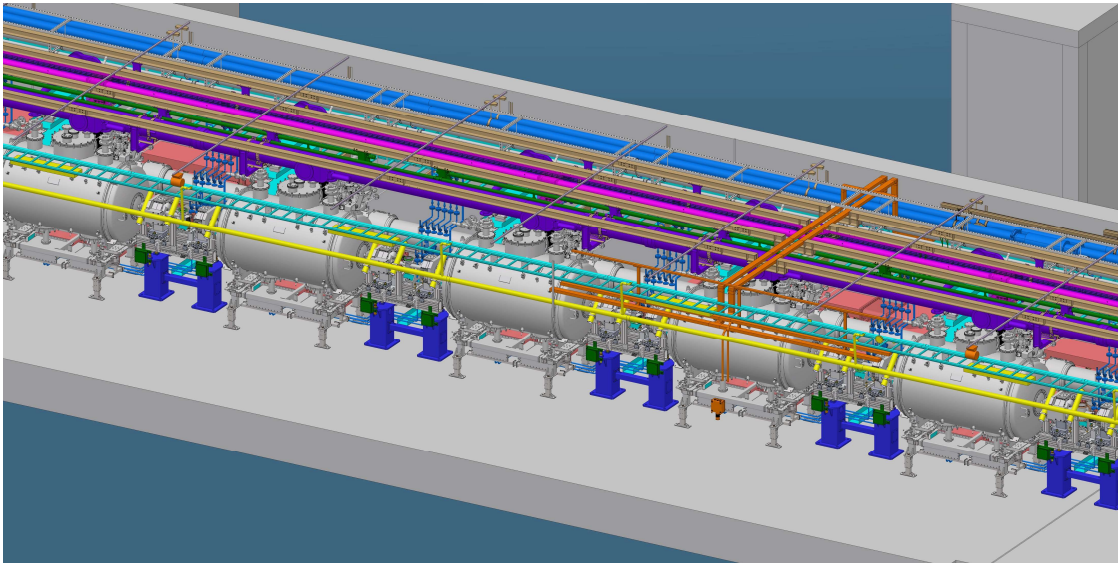
- 2014/68/EU (Article 4.3)
- EN 13480
- EN 13458
- ESS interna krav



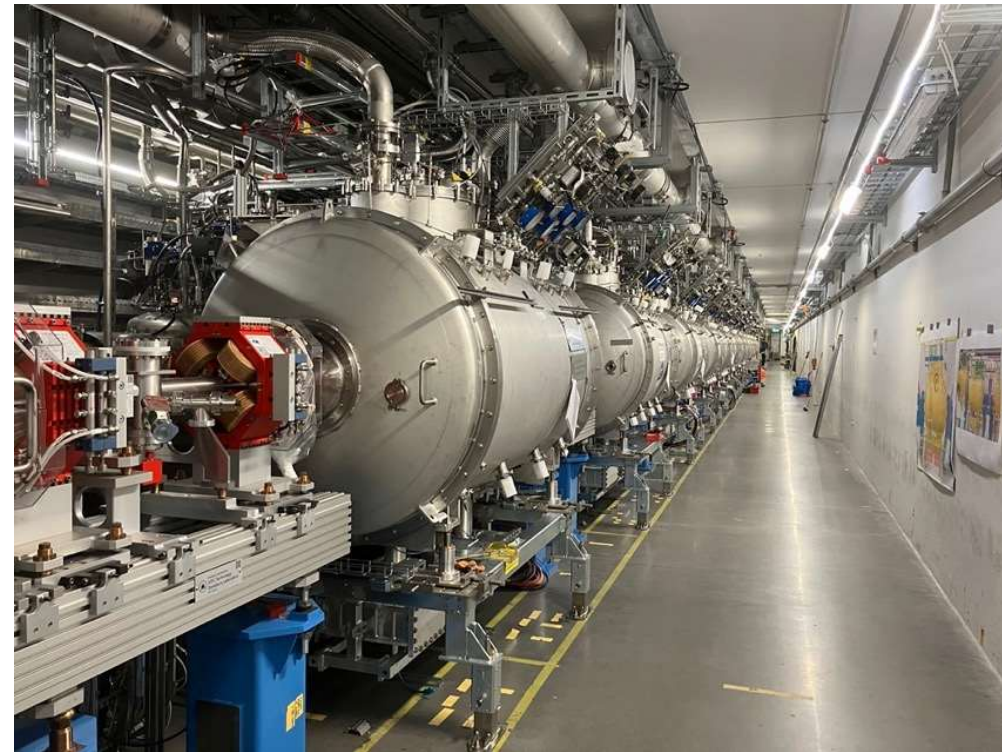
ESS Cryogenic Distribution System (CDS)



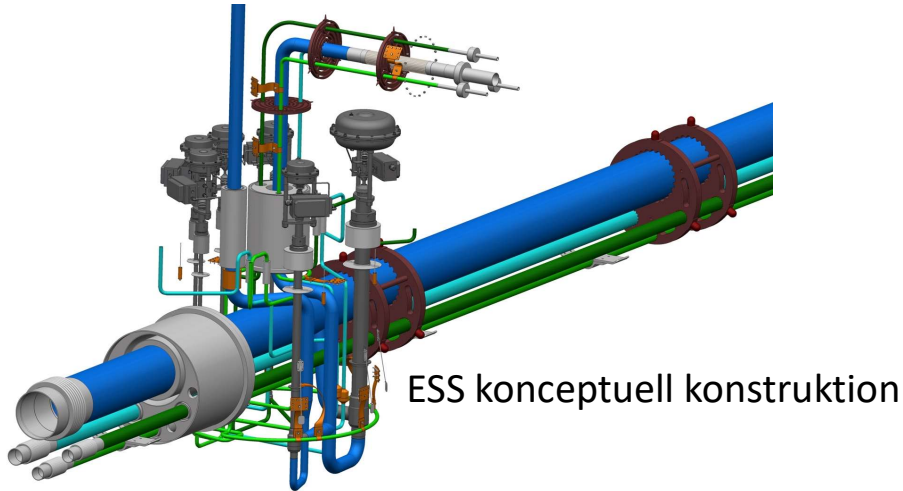
- 43 Valve Boxes
- 13 Header Units
- 43 Cryo Modules



ESS kryomoduler - CDS-SPK



ESS Cryogenic Distribution System (CDS)



CDS-SPK Valve Box

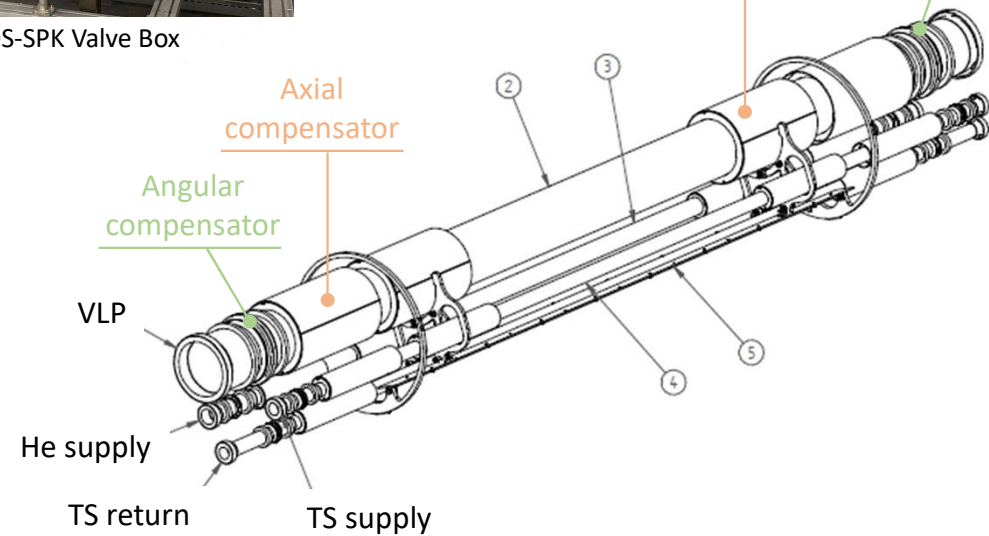


CDS-SPK Header Units

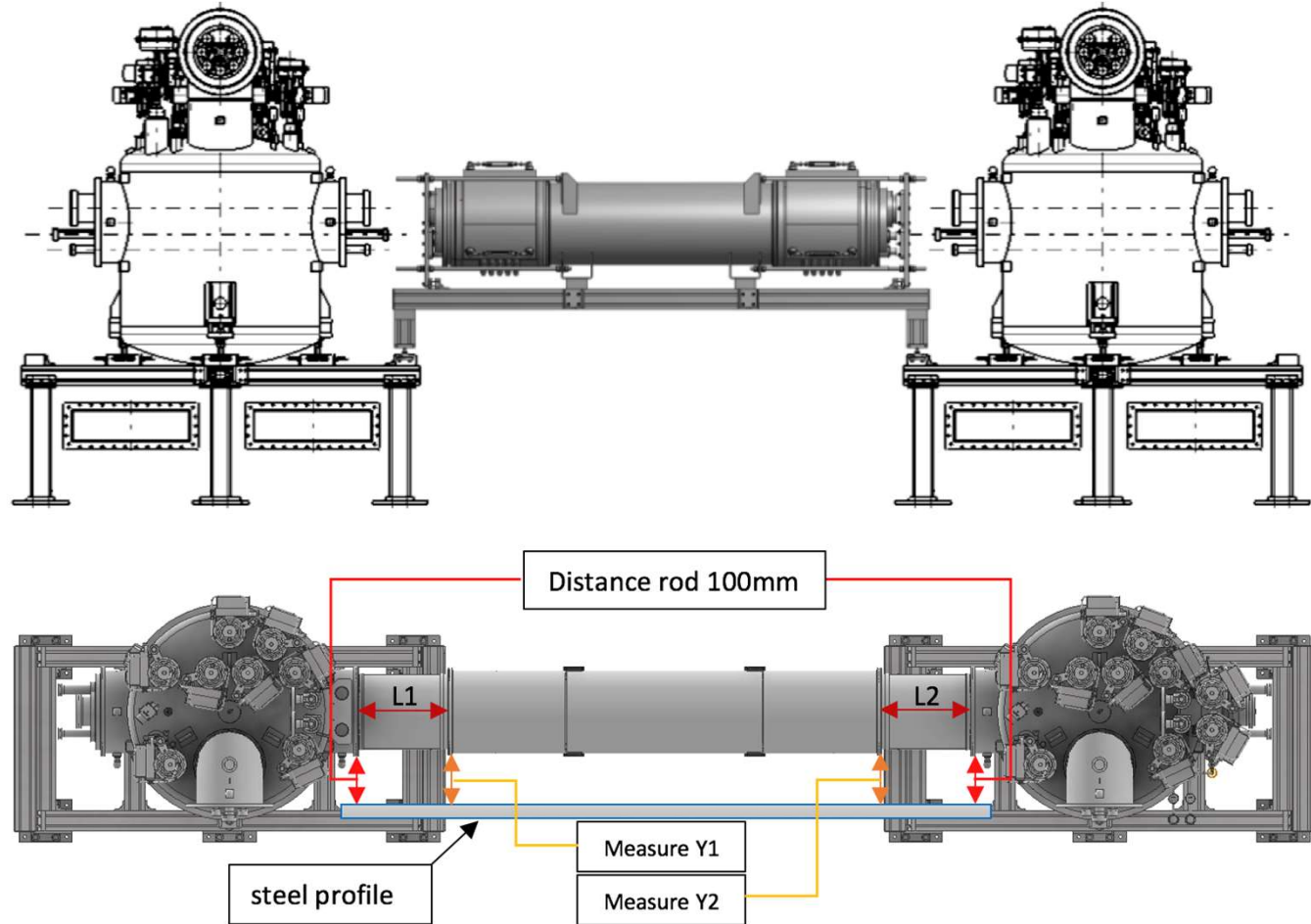
Axial compensator
Angular compensator



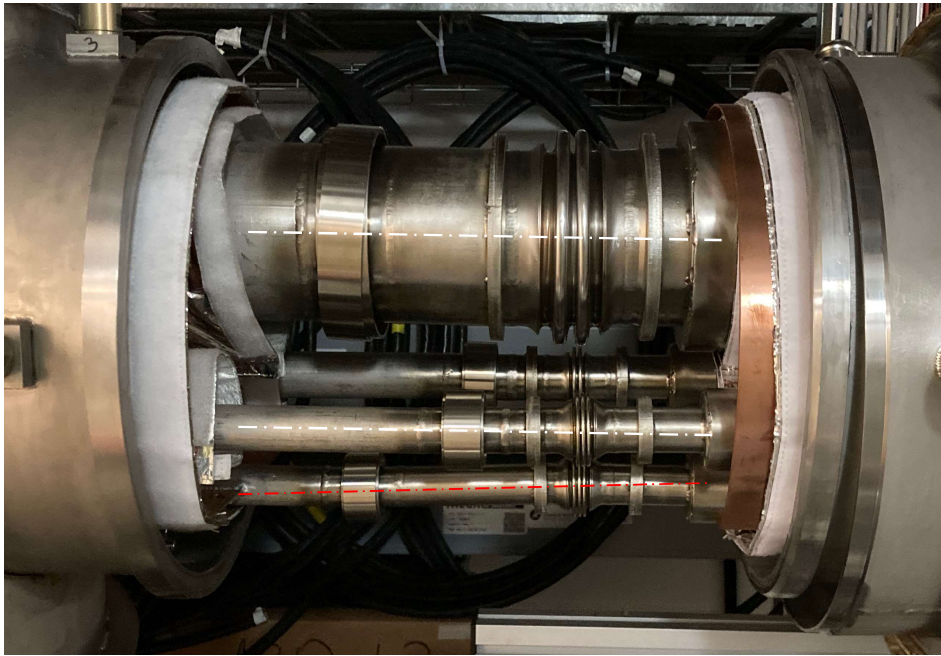
CDS-EL Valve Box



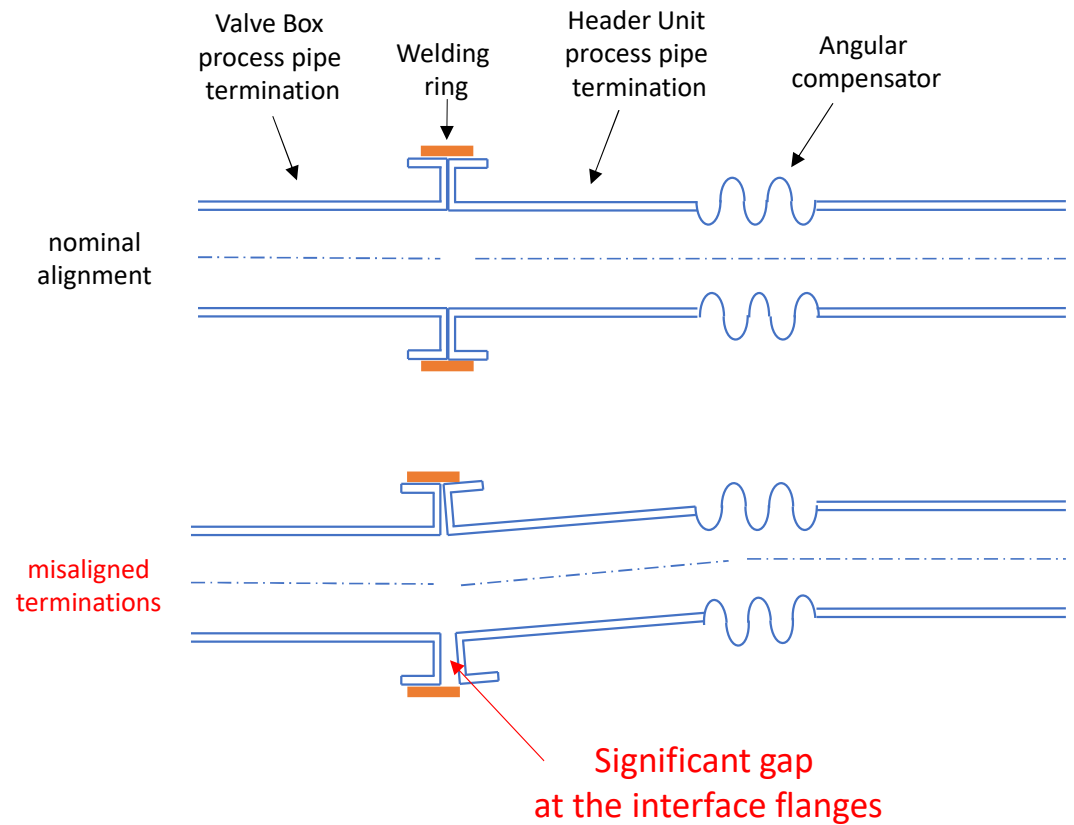
ESS Cryogenic Distribution System - (SPK)



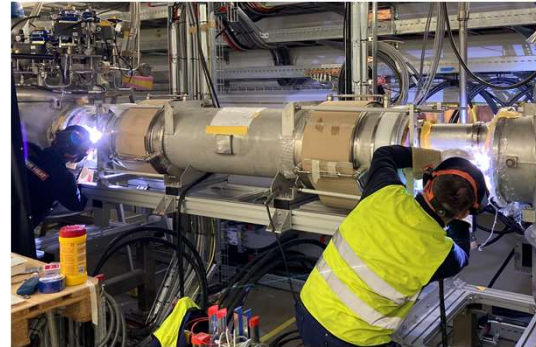
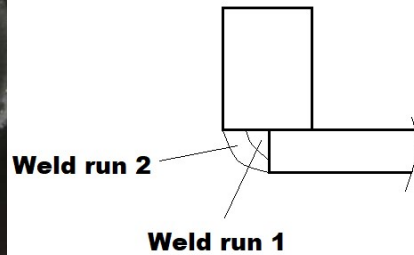
ESS Cryogenic Distribution System - (SPK)



Anslutningar VBox-HU

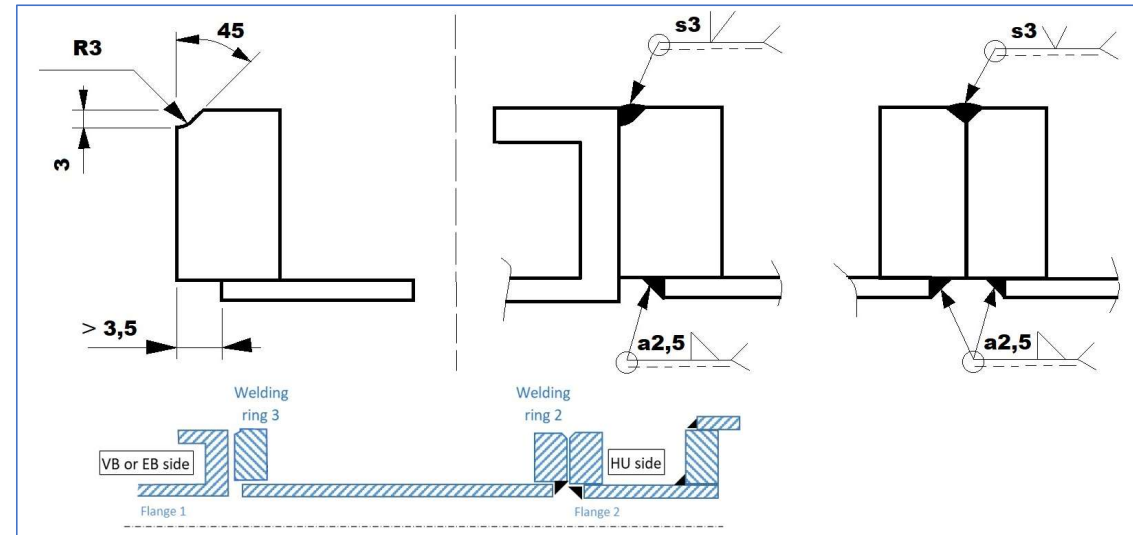


Cryogenic Distribution System for the Elliptical Linac (SPK)

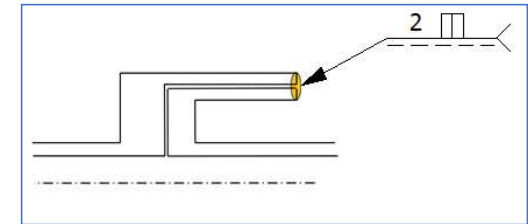
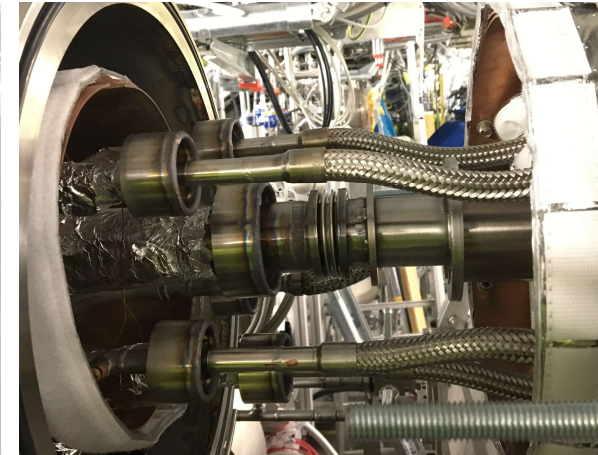
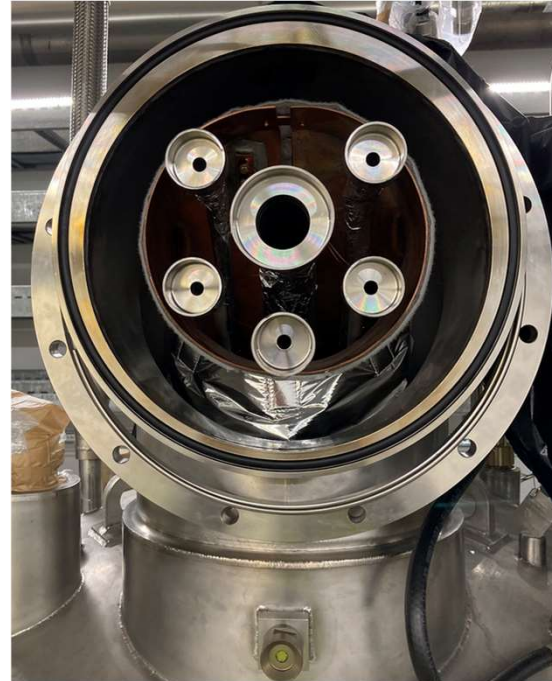
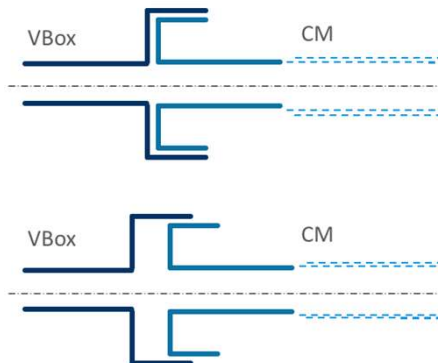
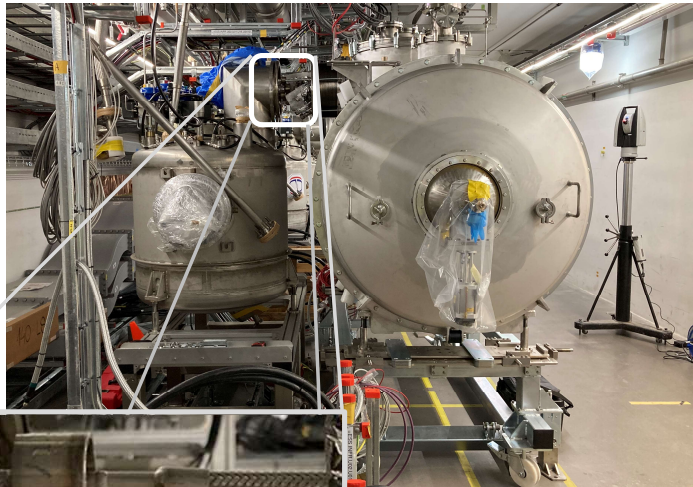


Processrör CDS

- 260 skarvar
 - TIG (141), partiell stumfog och kälsvets
 - Produktionsprov
 - 100% VT
 - 100% He-läcksökning

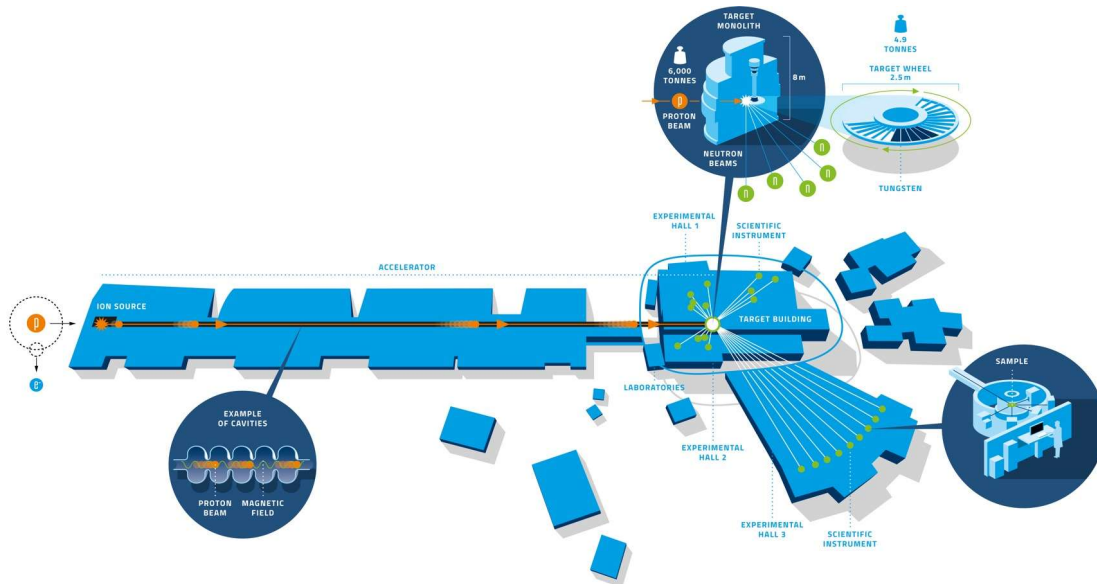


Cryogenic Distribution System for the Elliptical Linac



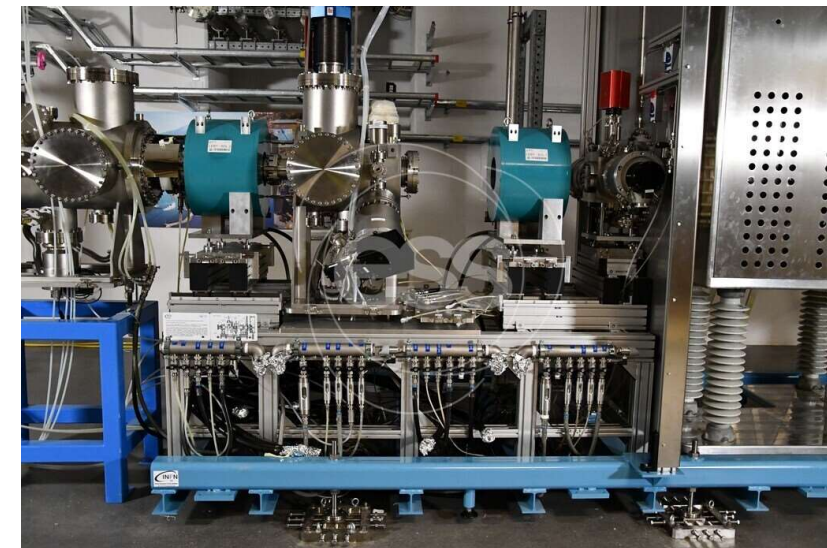
- | | | |
|------------------|------------------|--------------|
| 1. Positionering | 4. Svetsning | 7. Svetsning |
| 2. Uppmätning | 5. OFP | 8. OFP |
| 3. Kapning | 6. Positionering | |

Utmaningar inom projekt "Big Science"



- "One-of-a-kind"
- Unika kravspecifikationer
- Drift – 45 år
 - Modifieringar
 - Underhåll

“ Inspection does not improve the quality, nor guarantee quality. Inspection is too late. The quality, good or bad, is already in the product. As Harold F. Dodge said, “You can not inspect quality into a product.” ”



ESS Ion source

Slut / The End / Fin

THANK YOU

Acknowledgement

Tack!

Jaroslav Fydrych
Cryogenic Engineer
ESS, Lund