



ESS
bilbao



The ESS helium cooled rotating target: Final design stages, manufacturing process and FAT test

Consorcio ESS-BILBAO & European Spallation Source ERIC

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Introduction

Introduction

ESS project

ESS is an ongoing project to build a 5 MW spallation source in Lund (Sweden). Spain contributes with 3% of the total construction cost.

ESS construction site



ESS-BILBAO Consortium

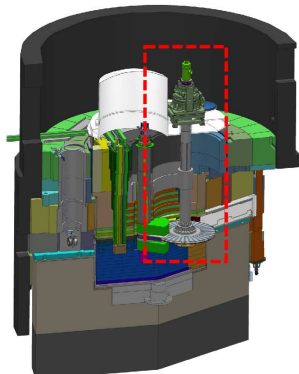
Role and functions

- ESS-Bilbao is public consortium between Spanish Central Government and regional government of Vase Country region.
- ESS-BILBAO has been nominated as Spanish representing entity for ESS operational phase.
- Staff of 50 scientists & engineers.
- On November 2014, ESS-Bilbao was chosen as ESS partner for Target Wheel, shaft and drive unit.
- Target Vessel CDR completed on July 2019.
- Manufacturing of Target Vessel and shaft completed along 2021-2022
- FAT test of the complete system (HRU and VF excluded) on Q1-2023
- System delivered to ESS on Q2-2022
- HRU delivered to ESS on September 2023 (Graphite degradation analysis not completed)
- **Final SAT test on MUTS on going.**

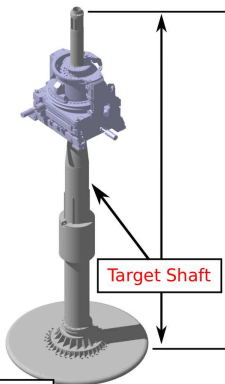
The Target wheel

The Target System

ESS Target system on ESS target station



ESS Target Station



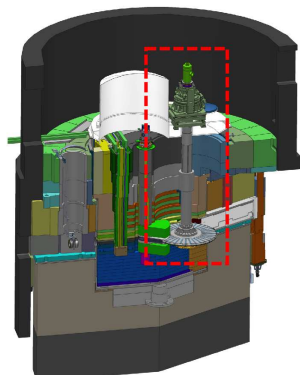
Target system

Challenges for ESS Target

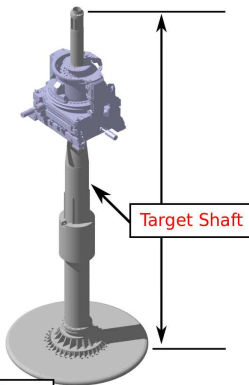
- 5 MW target
- Helium cooled
- Rotating device
- 125 000 h.MW life time
- Safety related equipment
- RCC-MR_x N2Rx
- 8 mm high
- 17000 kg mass

The Target System

ESS Target system on ESS target station

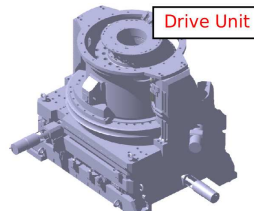


ESS Target Station

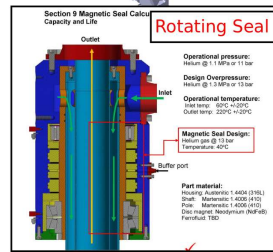


Target Shaft

Target system



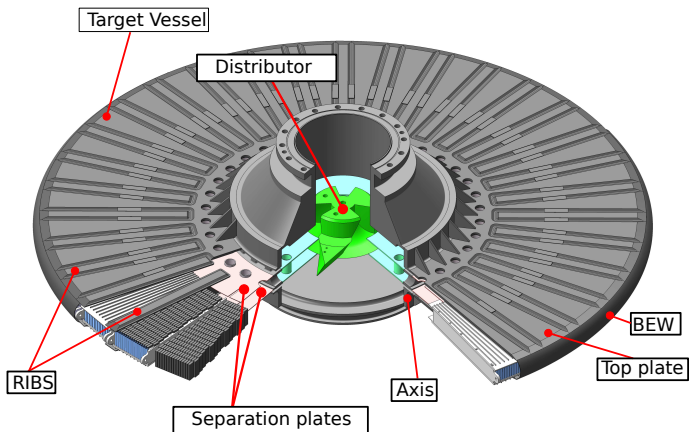
Drive Unit



The Target wheel

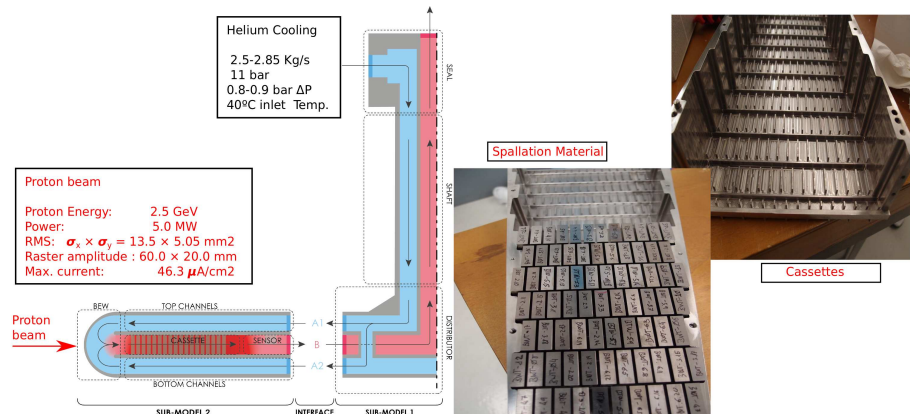
The Target Wheel

ESS Target system



The Target Wheel

Target main parameters and interfaces

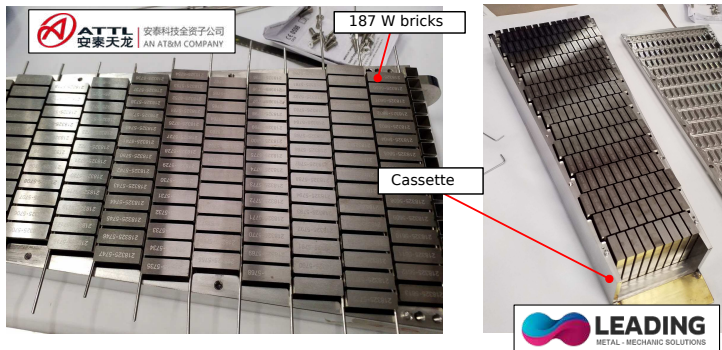


The Target Wheel: Spallation material

Spallation material

The spallation material is composed by 10x30x80 mm tungsten bricks (manufacturer by ATTL). The bricks are assembled in an stainless steel structure (Cassette, manufactured by Leading) in cross flow configuration. The cooling channels are configured by the space in between bricks.

Cassette Assembling



The Target Wheel: Target Vessel

Target Vessel Welding process

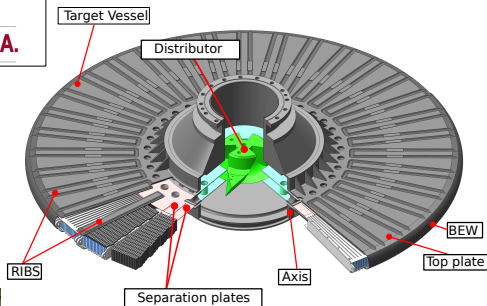
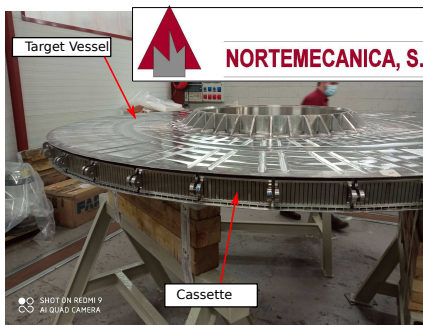


The Target Wheel: Target Vessel

Target Vessel: Cassette assembly (Q3- 2021)

The 36 cassettes are assembled in stainless steel vessel (manufactured by Nortemecanica). The Target Vessel includes the internal structures that distribute the helium flow from the target shafts to the cassettes.

Target Vessel

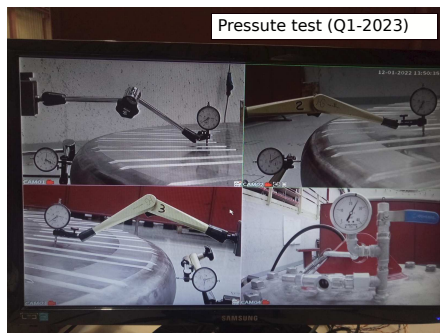


The Target Wheel: FAT Test

Final machining and pressure test (Q4 2021 / Q1 2023)

On the final stage, the PBEW was welded and external sureface was machined. Pressure test (23 bar) was completed on January 13^th, 2022.

Pressure test on Nortemecanica facilities



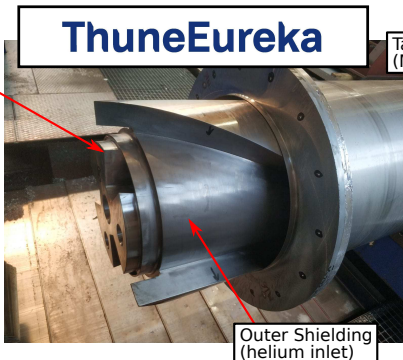
The Target Shot & Drive Unit

The Target Shaft & Drive Unit

Target Shaft

The Target Shaft is a coaxial pipe that guides the helium flow to the Target Vessel (manufactured by Thuneureka, completed on Q4 2020). It includes helical shielding to stop neutrons optimizing the helium pressure drop.

Target Shaft

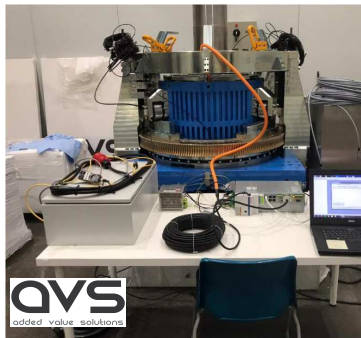


The Target Shot & Drive Unit

The Drive Unit

The drive is the movement unit of the Target system. It includes the main bearings, the torque motor and a displacement system form X-Y-Z movement. FAT test was completed on Q1 2021.

Drive Unit FAT



Integrated FAT test (without HRU)

Integrated FAT test (without HRU)

FAT test in (Thuneureka facilities)

The Wheel+ Shaft + Drive unit was tested on Q2-2022. This test was completed without the helium rotatory seal, thus, some work was still missing.

Drive Unit FAT



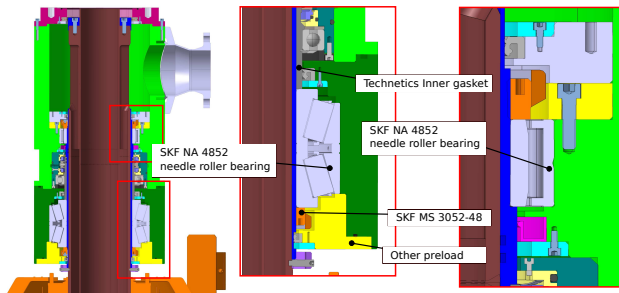
The Helium rotatory Union)

The Helium rotatory Union

The HRU

The HRU is based on a turn key seal solution provided by Technetics (graphite dry seal) integrated in a vessel. The vessel includes two bearings to prevent loads to be transfer to the dry seal. Partial FAT test was completed on September 2023 but additional verifications are needed.

HRU based on Technetics dry seal system

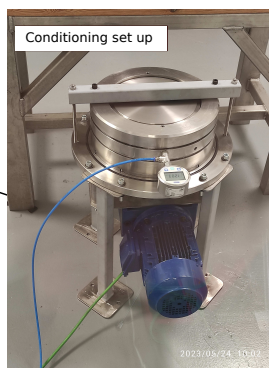


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HRU based on Technetics dry seal system

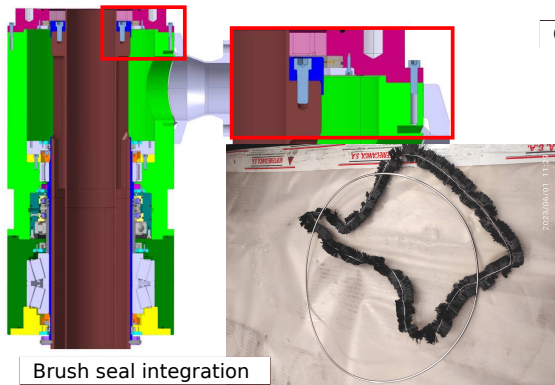


The Helium rotatory Union

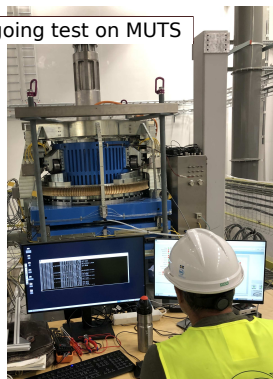
The HRU: On going test

ESS is running a 1000 h test (Lead by K. Sjogreen) on MUTS. After this test, the seal will dismantle to evaluate the degradation of the graphite surfaces to check his life time. The brush seal integration is still on going.

HRU based on Technetics dry seal system



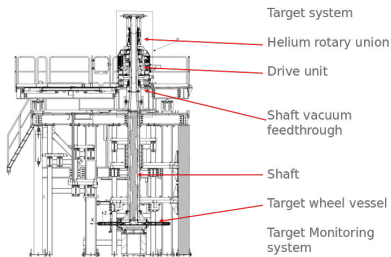
On going test on MUTS



Integrated test on MUTS

Integrated test on MUTS

The MUTS test stand



Only Functional testing in this presentation.

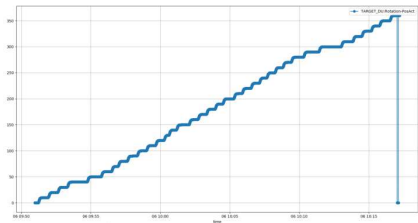
The following functions have been tested and validated

- Homing and alignment
- Stable operation
- Translation
- Synchronisation
- Lubrication system
- Vibration and bearing monitoring system

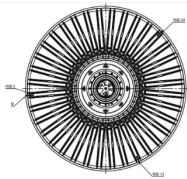
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Integrated test on MUTS

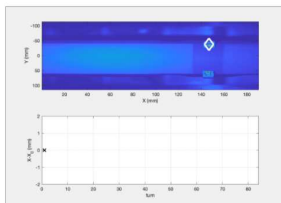
Movement test



Homing- and alignment procedure tested in the MUTS



Camera synchronised with the timing signal (14 Hz/36 sectors)

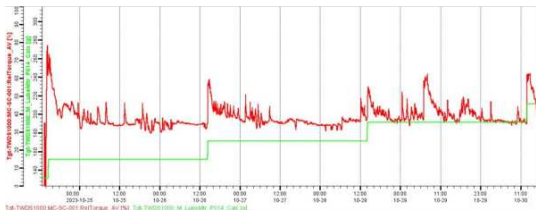


The synchronisation with the timing system was tested using the beam instrumentation system.

Integrated test on MUTS

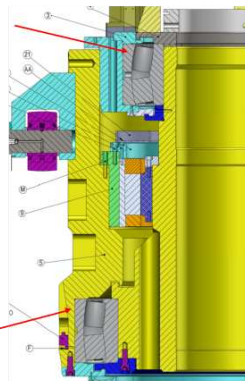
Relubrication vs torque for the drive unit bearings

The torque response for each relubrication of the machine was monitored. The torque is now stable around 40 % (of 600 Nm)



Tiga:TA251000 MC-SC-200 RealTorque_Air [Nm] Tiga:TA251000 M Landed_PCL1_100 [s]

Locating bearing



Non-Locating bearing

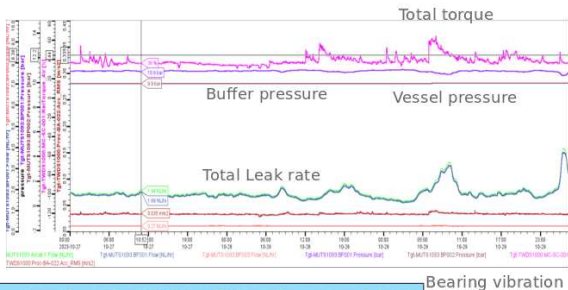
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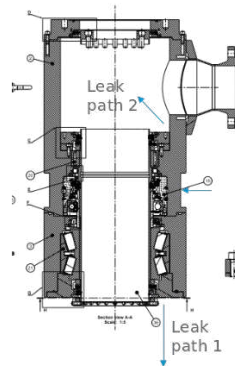
Integrated test on MUTS

Leak rate- Helium rotary union

The leak rate for the Helium rotary union was monitored. It is now stable around 2 Normal- liters per hour (Requirement is 3)



After testing the HRU will be disassembled
The wear will be inspected.



Conclusions)

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Main remarksRole and functions

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