ESS bilbao

EUROPEAN SPALLATION SOURCE

Introduction of the Target Internal structures

Consorcio ESS-BILBAO & Instituto de Fusión Nuclear & ESS-ERIC

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Introduction to ESS-Bilbao in kind contribution

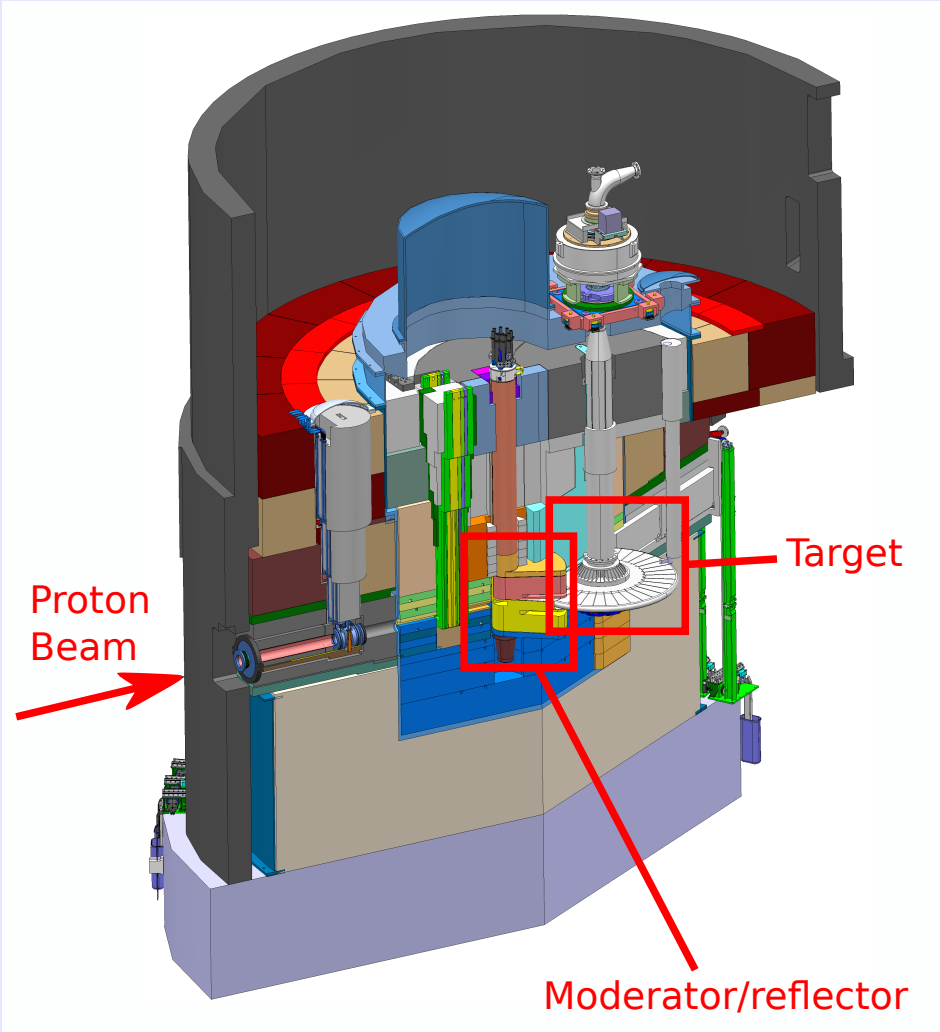
ESS-Bilbao in kind contribution (Target Station)

Role and functions

- The Spanish Government has taken the decision to make ESS-BILBAO the only contractor from Spain to ESS project.
- Staff of 65 scientists & engineers and the possibility to hire extra staff.
- ESS-BILBAO has been nominated as Spanish representing entity for ESS operational phase.
- ESS-BILBAO has already received the money for the following years activities ($>$ 20 M€) and additional grants will be provided in due time.
- ESS-BILBAO is a private entity, so we have a large flexibility to employ and subcontract.
- On November 2014, ESS-Bilbao was chosen as ESS partner for Target Wheel, shaft and drive unit.
- On October 2015, and International Panel Chair by Matt Fletcher evaluate the Target Base Line with positive feedback.
- On September 2016, Critical design review for the Spallation Material and the Cassettes.

ESS-Bilbao in kind contribution (Target Station)

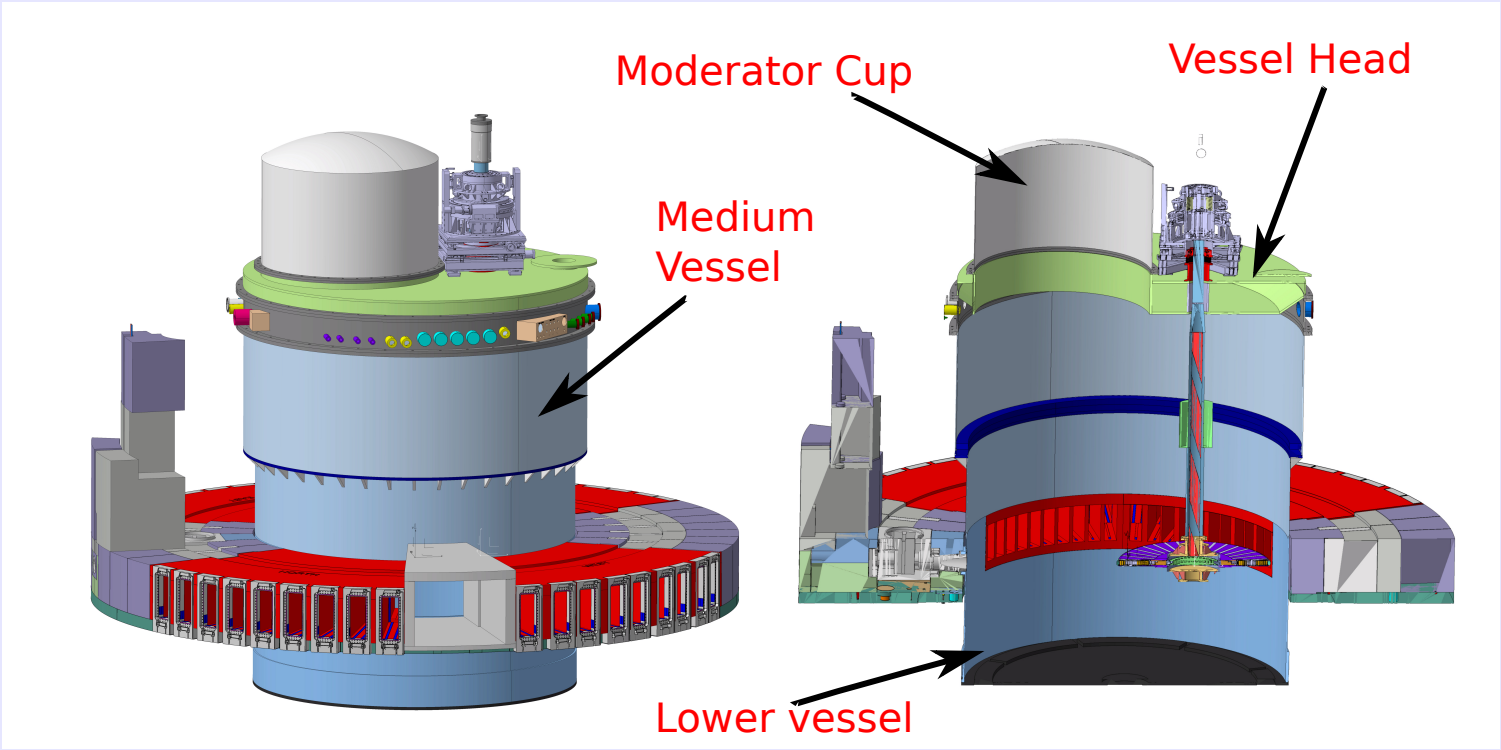
European Spallation Source Target Station



- 5 MW spallation neutron source
- 12 m x 6 m in diameter
- $\sim$ 2500 t. of steel shielding
- 40 neutron ports
- Total budget: 180 M€
- In kind: $\sim$ 100 M€

ESS-Bilbao in kind contribution (Target Station)

ESS-Bilbao Workpackages on ESS Target area



Neutron ports

On September 2016, Neutron ports are still under discussion.

The ESS Target

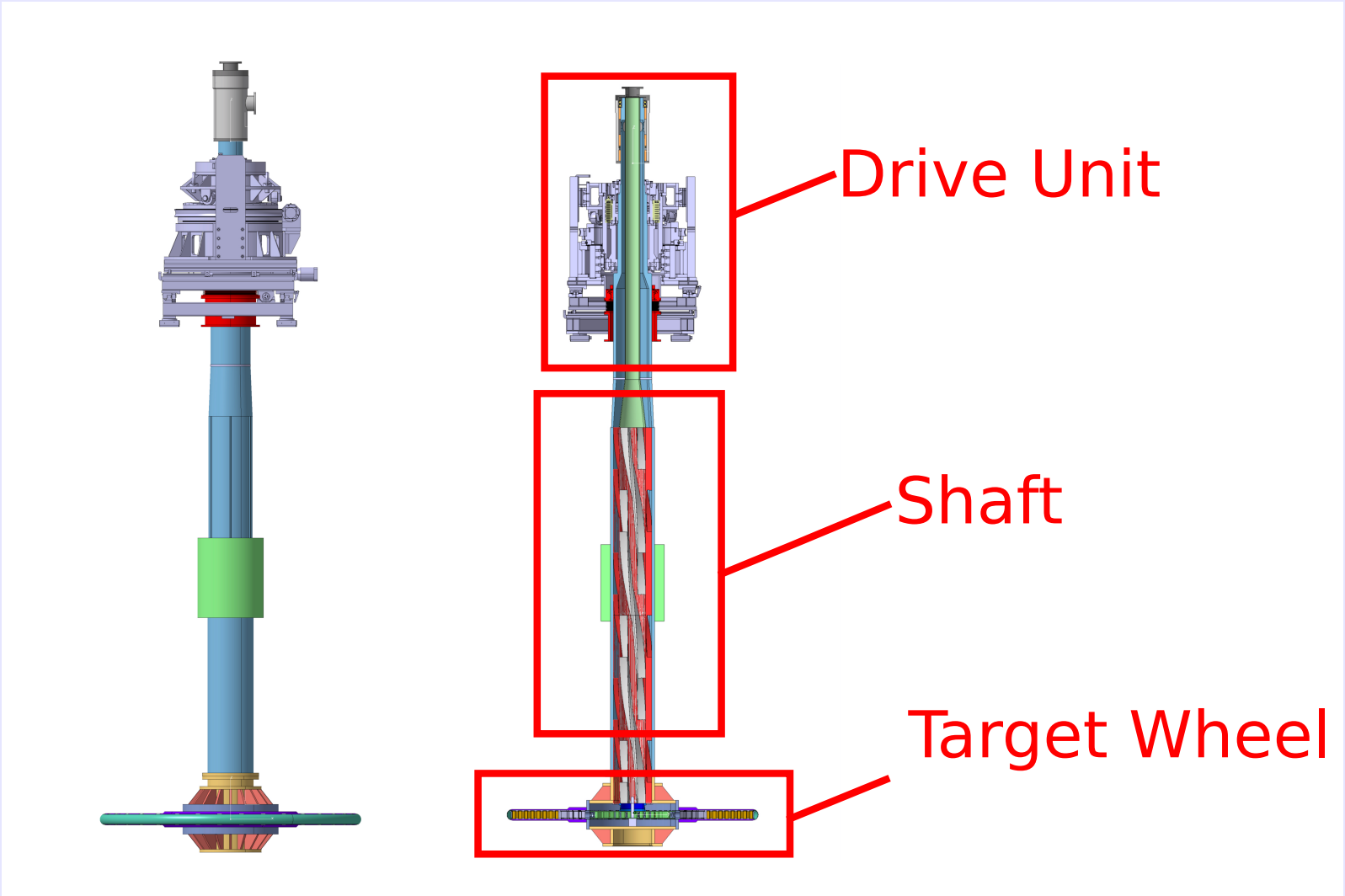
The ESS Target

Main Target parameters

- Spallation Material: Hot Rolled W
- Internal Structures and shielding: SS-316L
- Target Vessel and shaft: SS-316L
- Beam Power: 5 MW
- Max Proton Energy: 2 GeV
- Life Time: 5 years
- Coolant: helium
- Helium Pressure: 10 bar
- Helium flow mas: 3 kgs^{-1}
- RCC-MRx Class 2 Component
- Life time 5 years

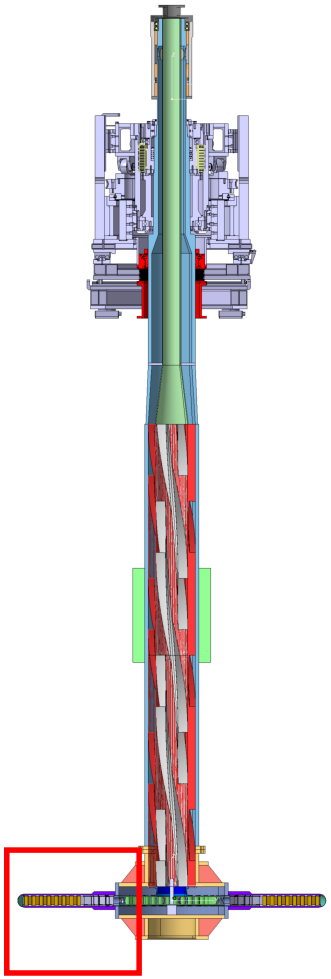
The ESS Target

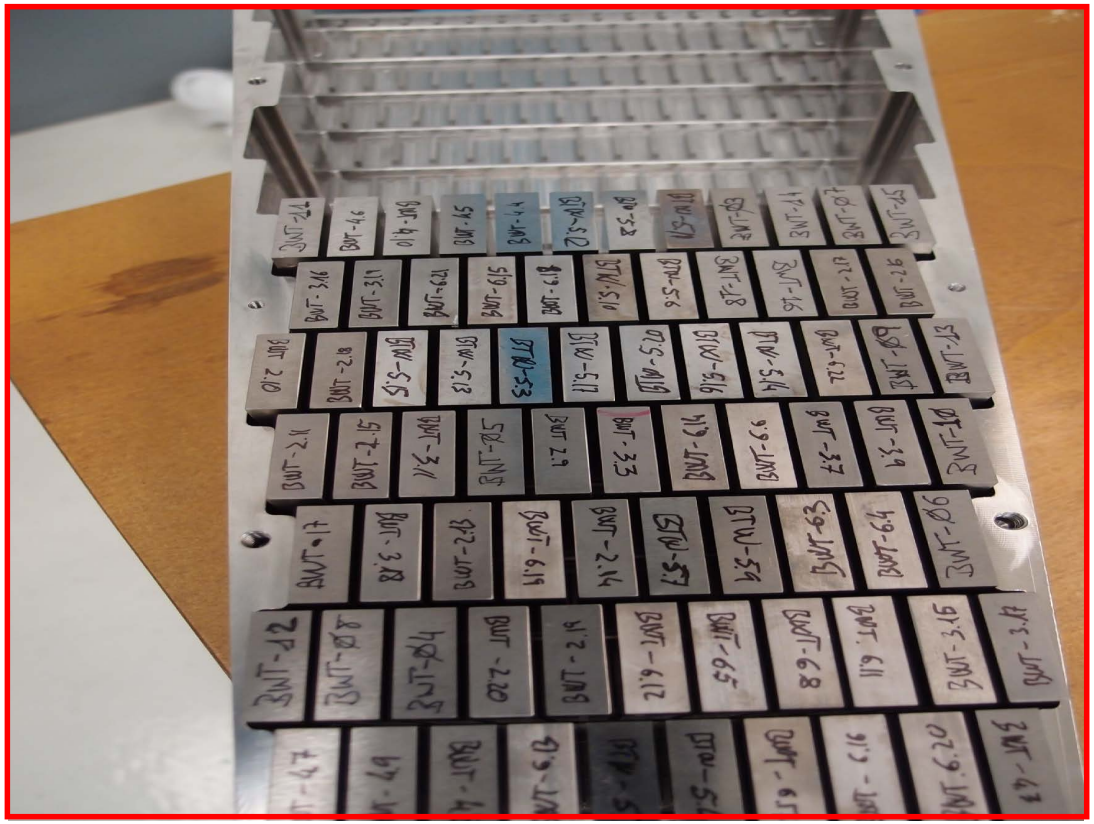
Main components: Target wheel, shaft and Drive Unit



The ESS Target

September 27th, Critical design review for Target Spallation Material

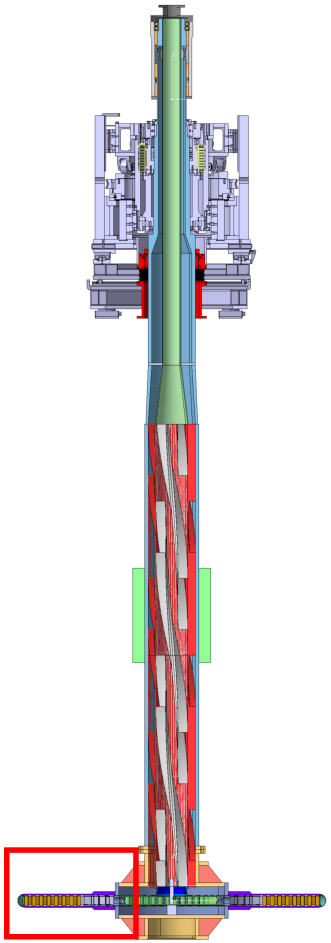


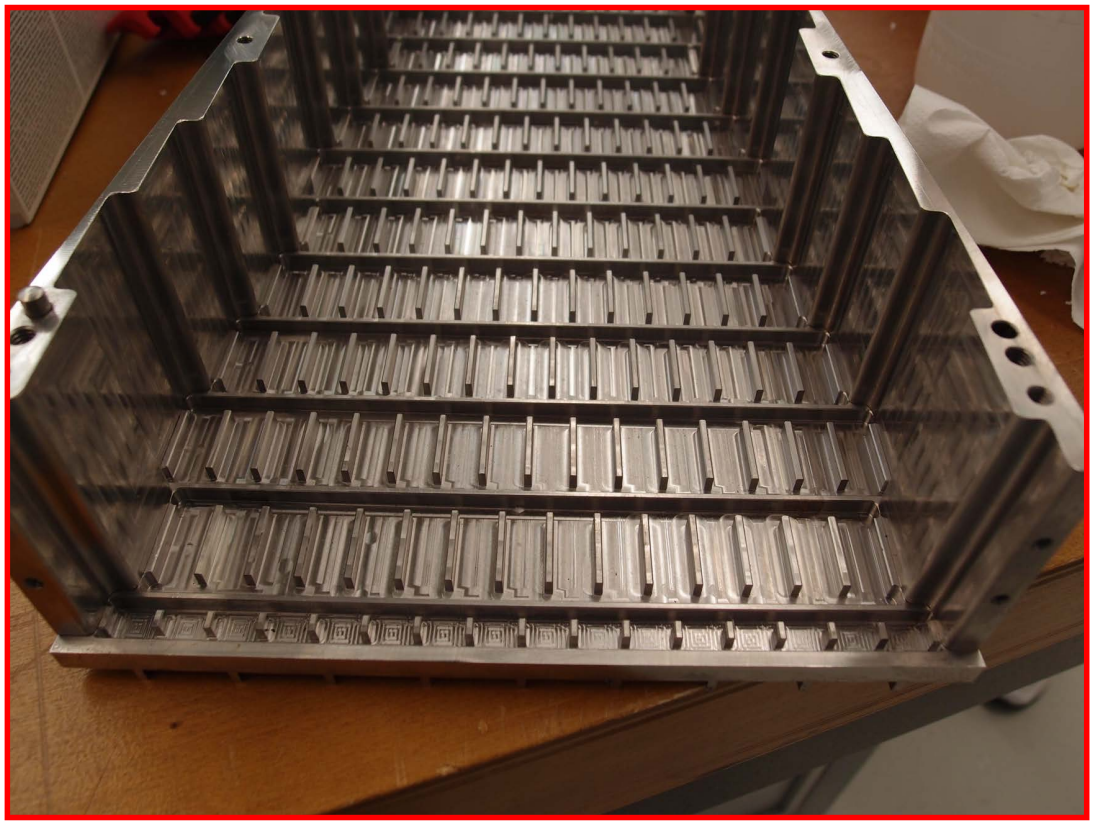


Spallation Material

The ESS Target

September 28th, Critical design review for Target Internal structures





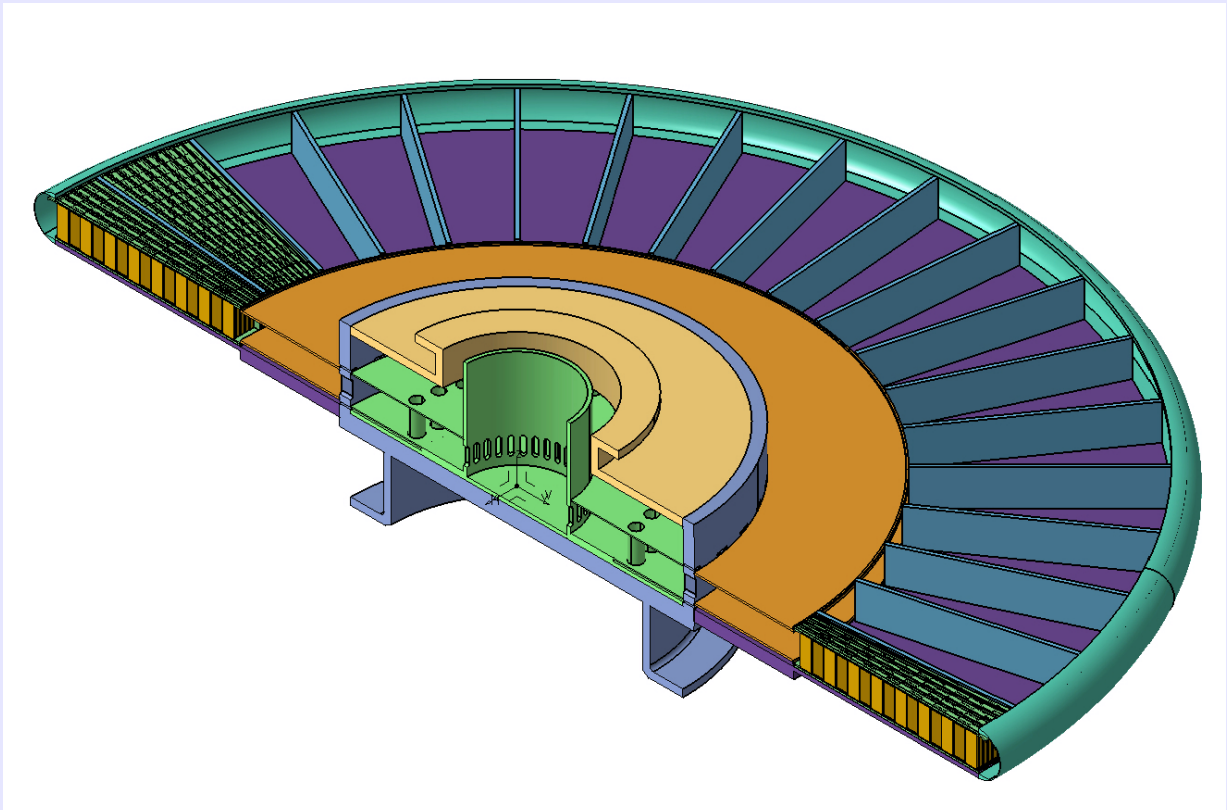
Internal structures (SS-316L)

The ESS Target

The Target Wheel

The Target Wheel includes the spallation material, internal structures and target vessel. Target Vessel is not in the scope of this review. However boundary conditions between both systems are close connected.

Target Vessel configuration

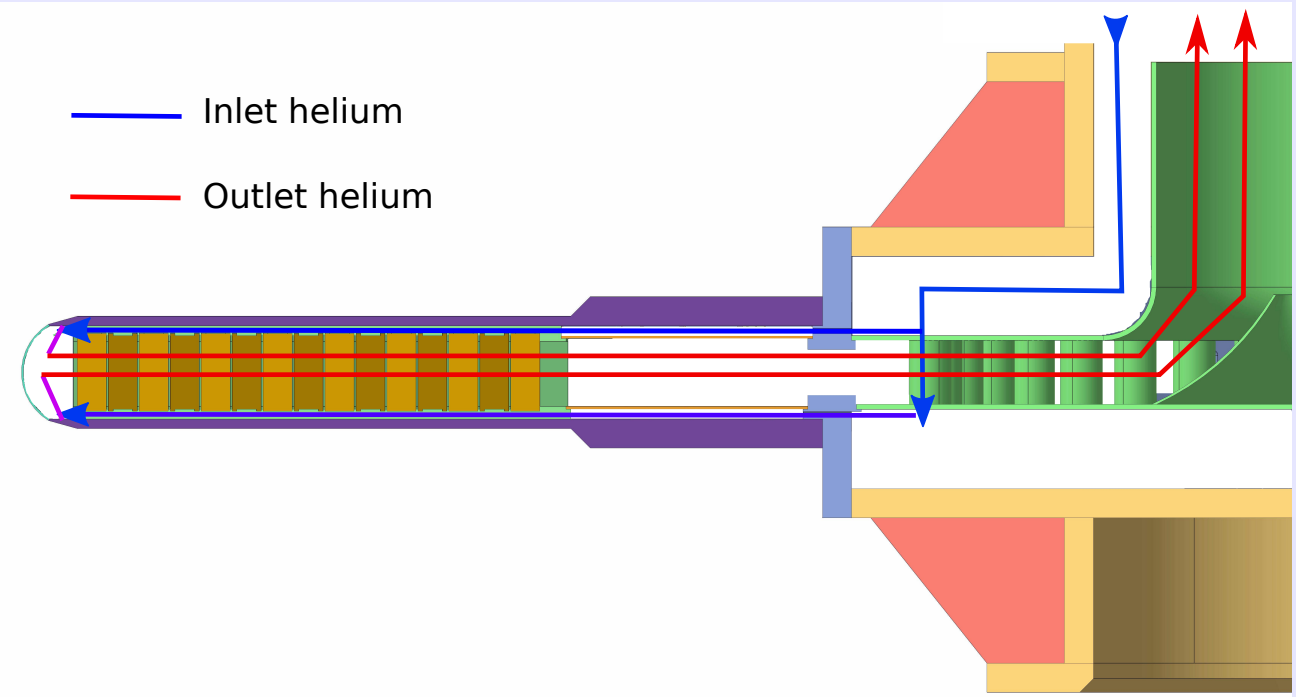


The ESS Target

The Target Wheel

The Target Wheel is the structure that configures the structure that withstand the spallation material and configures the helium flow path. It is not in the scope of this review. However boundary conditions between both systems are close connected.

Helium flow path



The internal structures: The Cassettes

The internal structures: The Cassettes

Description

The cassettes are the steel structures that withstand the spallation material. To configure the Target, 36 of them are assembled inside the Target Vessel.

Functionality

- Withstand tungsten bricks and configures the helium channels in between them.
- Configures the inlet helium channels in the gap between ribs and target vessel
- Allows the dismantling of the target spallation material in a single operation per 187 bricks.

The internal structures: The Cassettes

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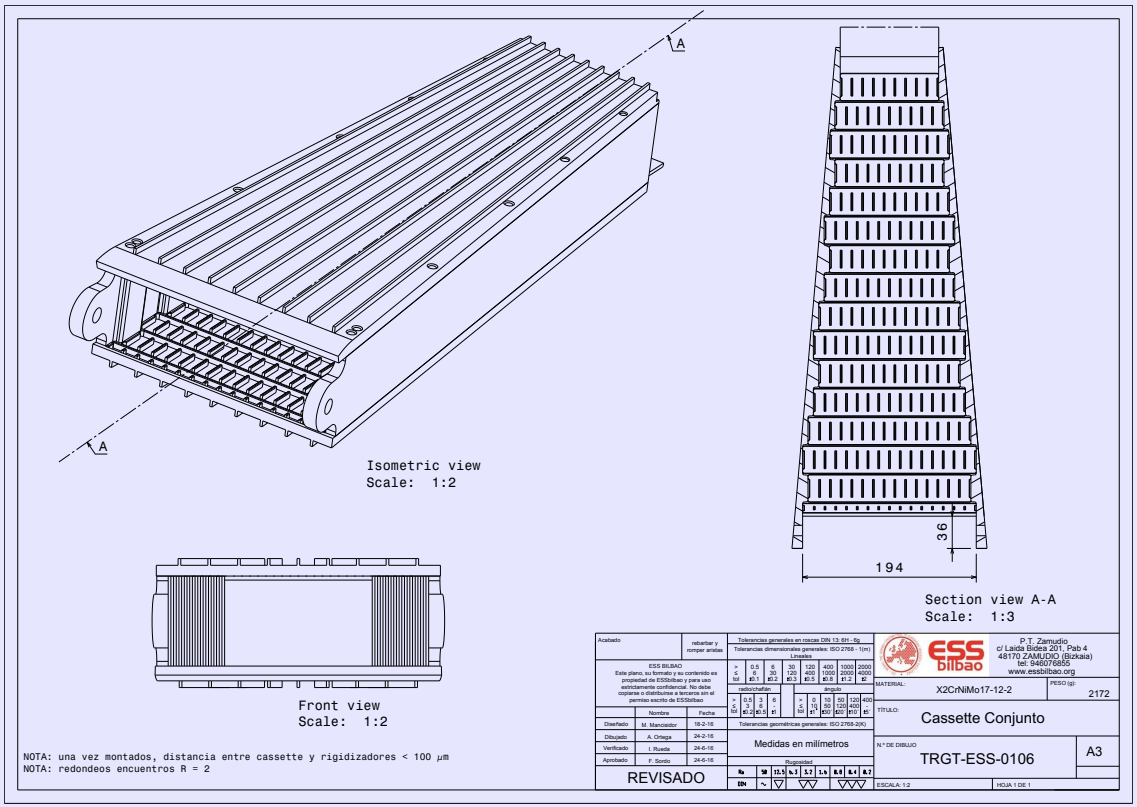
Cassette components



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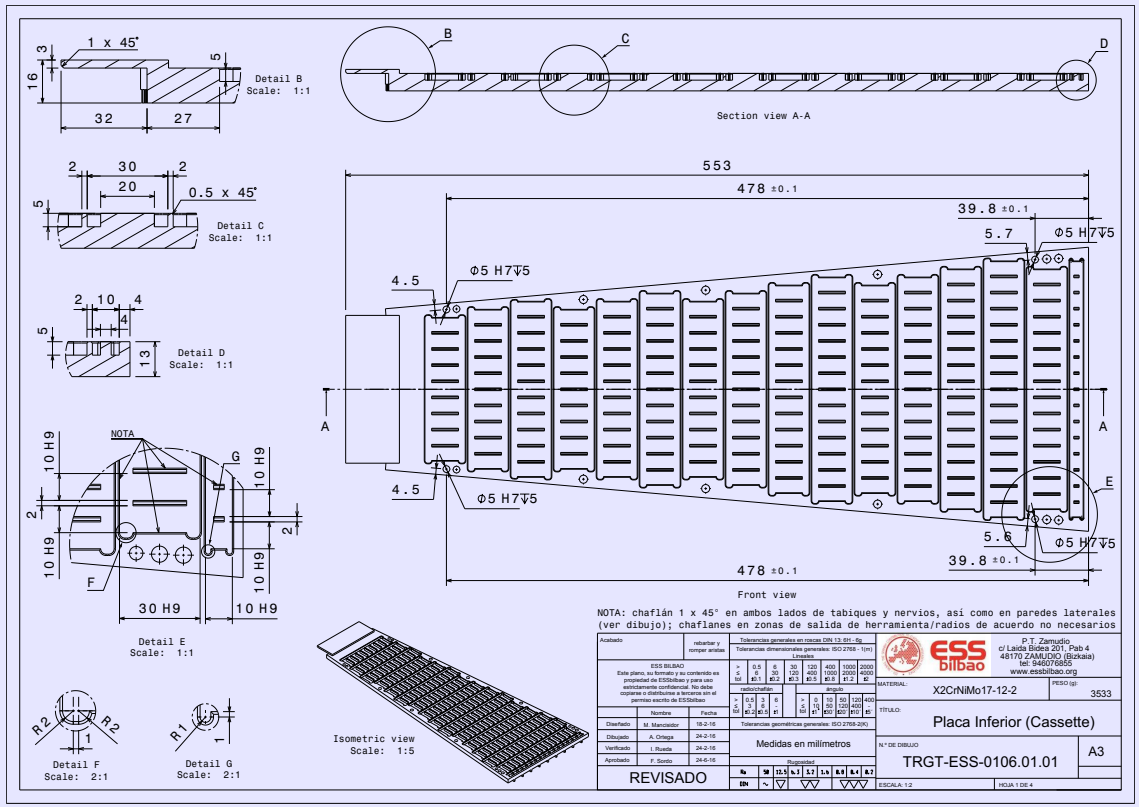

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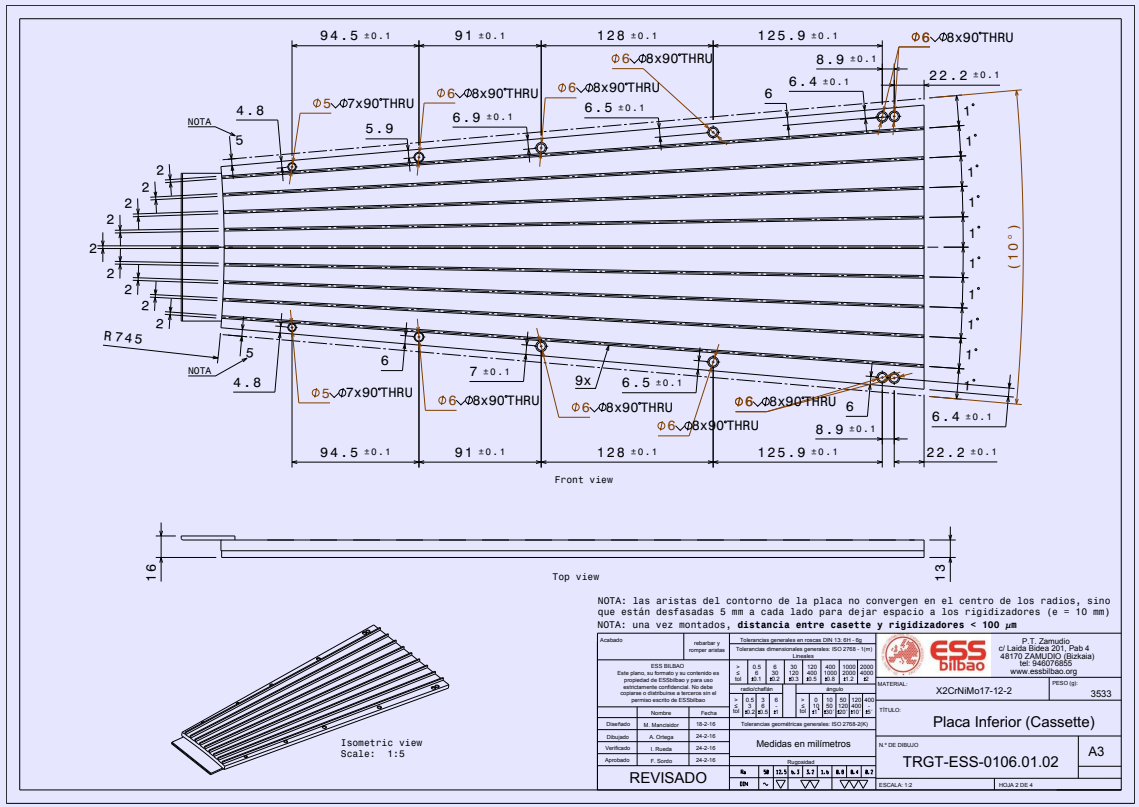

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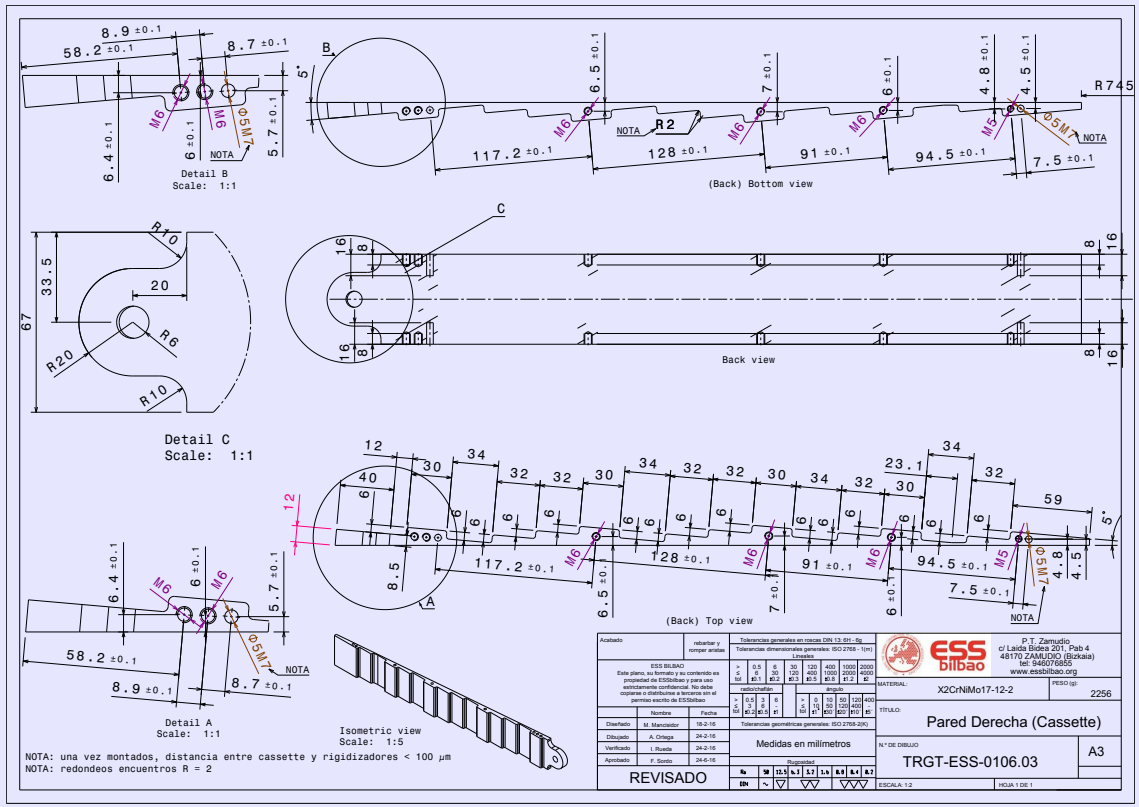
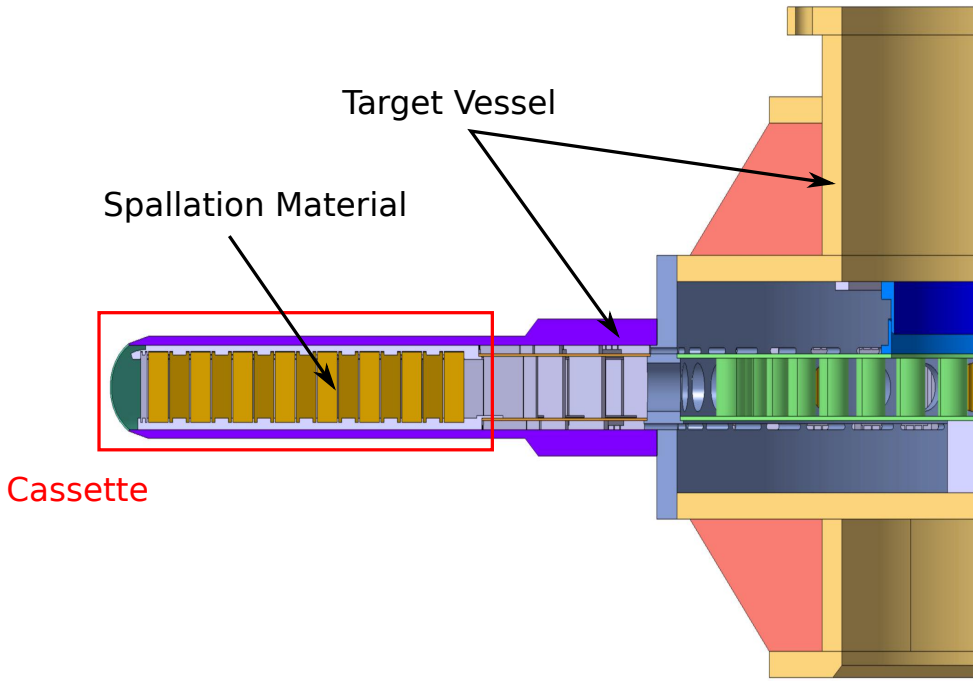


The internal structures: The Cassettes

Assembling process in the Target Wheel.

After the manufacturing and testing of the cassette, the spallation material is inserted at ESS-Bilbao facilities. The 36 cassettes will be shipped from ESS-Bilbao to the Vessel's manufactured facilities for the final assembling. They will be inserted radially in the vessel.

Process: Radial insertion and front face welding.



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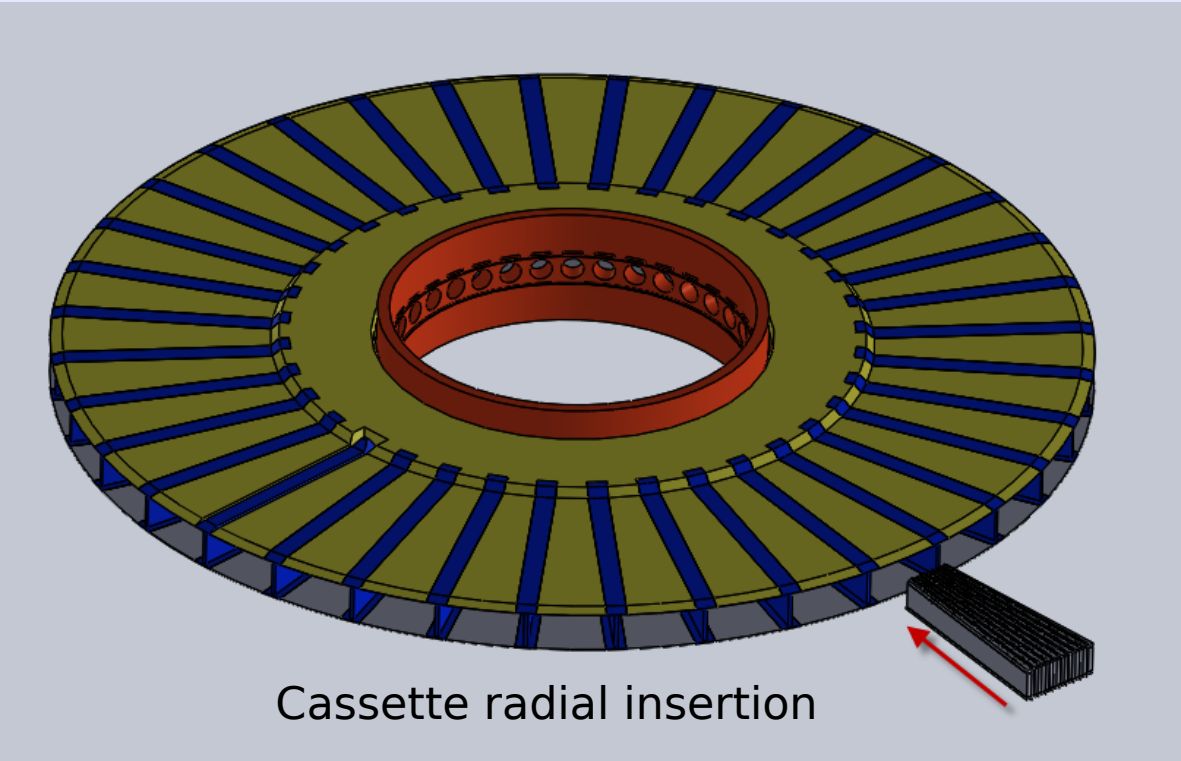

Cassette radial insertion

The internal structures: The Cassettes

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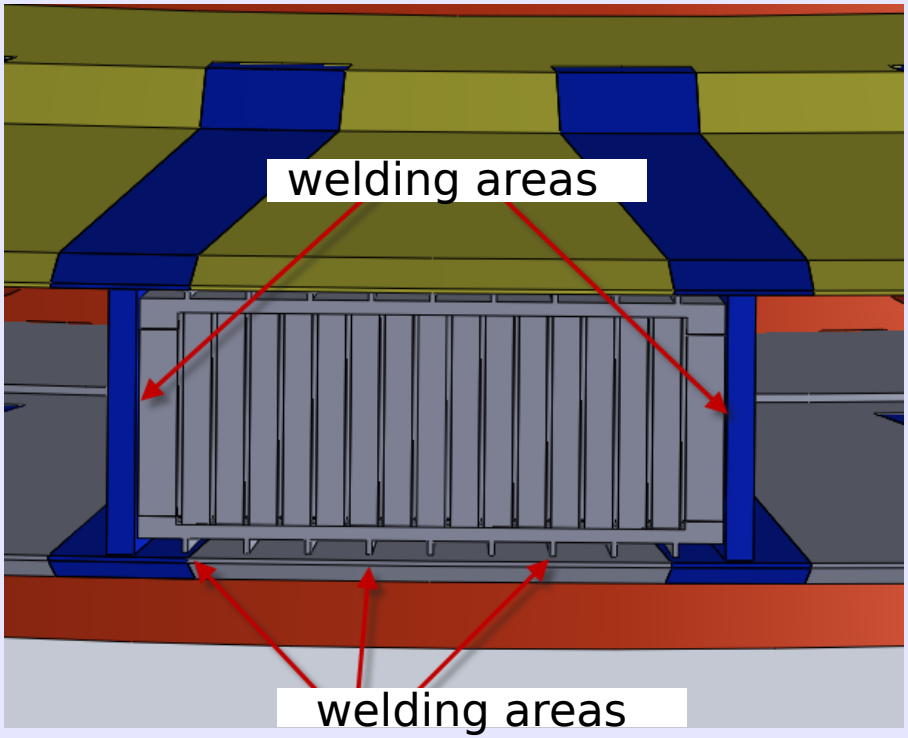
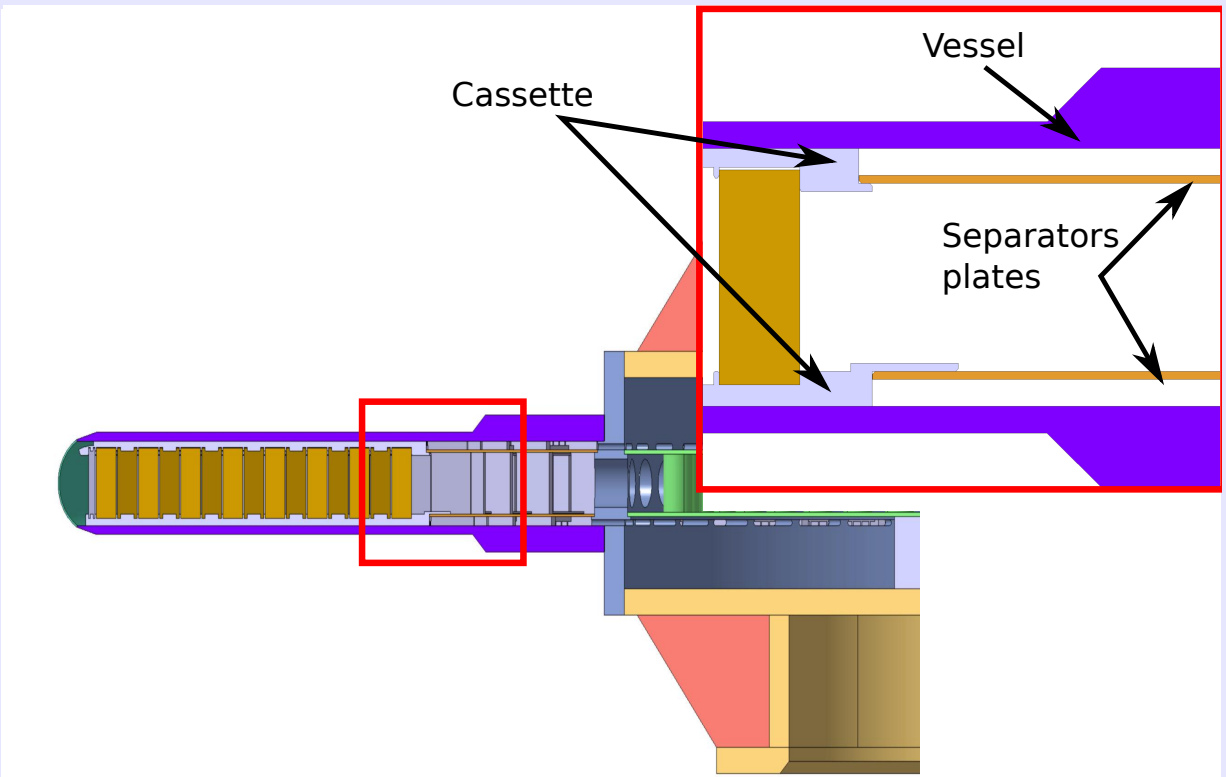


The internal structures: The Cassettes

Assembling process in the Target Wheel.

The bottom part of the cassette is not welded to the vessel based on Remote handling dismantling constraints. The possible baipas between channels will be avoided by the differential pressure ($\sim$ 0.15 bars).

Process: Radial insertion and front face welding.



Load Scenarios

Loads scenarios

SF levels

- SF 1 and 2 are operating conditions associated with Normal operation, start and stop, and normal operational incidents.
- SF 3 Conditions are Operating Conditions which are rare and leads to shutdown and inspection, limit to 10 times in the lifetime.
- SF 4 Conditions are highly improbable but relevant for safety.

Load cases not considered for design proposes

- **Unsynchronized wheel:** The lost of synchronization can produced a significant amount of heat in the lateral areas of the cassette. Nevertheless, the cassette is not an structural element of the vessel and it is perfectly cooled due to the helium flow so, the increase of temperature will not produce any relevant effect for the design. This accident will be consider in detail in the design of the Target Vessel.

Loads scenarios

Scenarios considered on the design process

Requirement	Loads	Level	Prot.
Operating Conditions	Nominal Beam Operating pressure (10 bar) Operational cooling conditions (3 kg s^{-1}) Wheel rotation	SF1	A
Vertically displaced beam	Vertically displaced beam Operating pressure (10 bar) Operational cooling conditions (3 kg s^{-1}) Wheel rotation	SF2	A
Unsynchronized wheel	Horizontally displaced beam Operating pressure (10 bar) Operational cooling conditions (3 kg s^{-1}) Wheel rotation	SF2	A
Shut-down	No beam Operating pressure (10 bar) No coolant flow Wheel stopped	SF3	D

Conclusions

Conclusions

Summary and remarks

- ESS-Bilbao has an in kind contribution to ESS Target station of 17.6 M€
- Several packages included in the Target interfaces (PBIP or Monolith Vessel) are included on ESS-B in kind contribution
- CDR for the cassettes is partial CDR of the Target Wheel.
- The cassette design is consistent with the Vessel deign and manufacturing process.
- Load scenarios that plays a role in the design process has been identified and considered in the analysis.