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Target wheel drive, bearings, and shaft seals design

Consorcio ESS-BILBAO & ESS-AB & AVS

F. Sordo, on behalf of ESS-BILBAO Team

April 6, 2017

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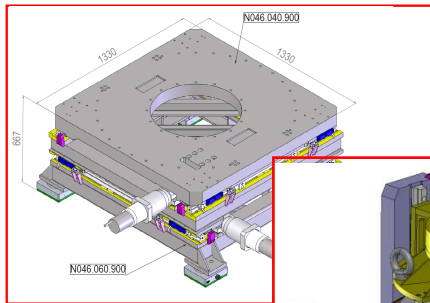
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Drive Unit

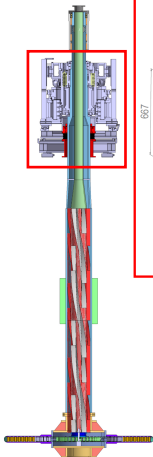
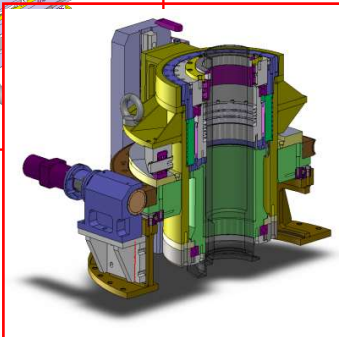
Drive unit

Introduction

Positioning unit



Drive Unit



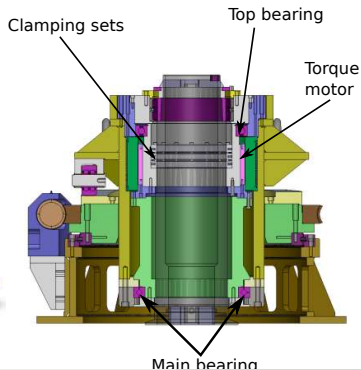
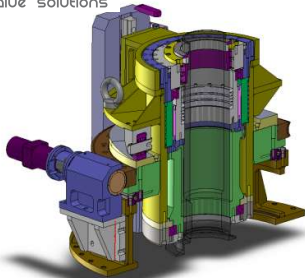
Drive Unit & Positioning system

Preliminary design

ESS-Bilbao awarded a contract to A.V.S. for the design and manufacturing of the Drive unit. The main components definition has been completed, including definition of the main bearing system, clamping system and motor. Detail engineering is on going.

Drive Unit

QVS
added value solutions



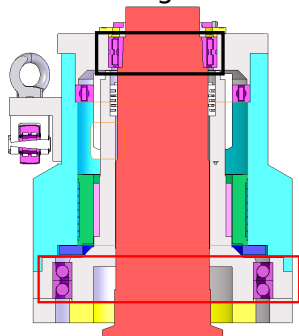
Drive Unit & Positioning system

Drive Unit

The system is supported by means of an two angular bearings (Frenke bearing) and one radial bearing (INA NNTR50) maximizing the distance between both supports.

Bearings

Radial bearing



Franke bearing



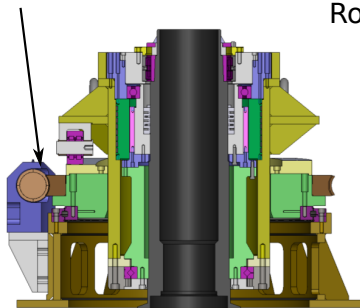
Drive Unit & Positioning system

Vertical displacement

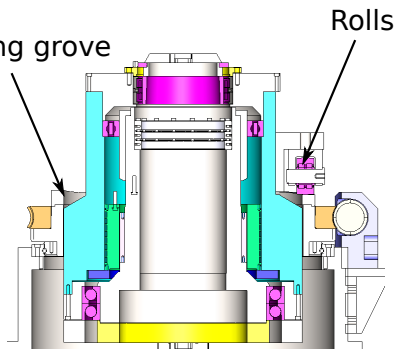
The vertical movement is produced by the rotation of drive based on a worm gear that displace three rolls in a groove with inclination. Vertical rails avoid misalignment of the system during the vertical displacement.

Guides and rollers for vertical movement

Worm gear



Rolling groove



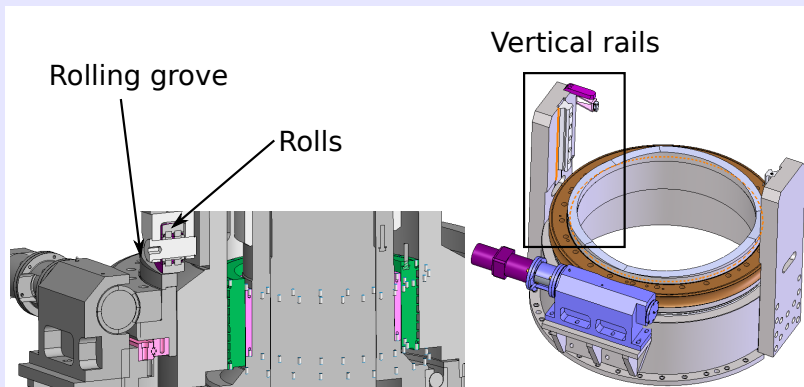
Rolls

Drive Unit & Positioning system

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Guides and rollers for vertical movement

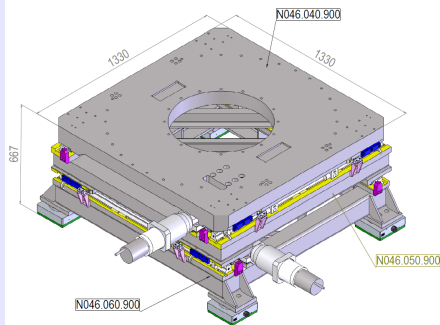


Drive Unit & Positioning system

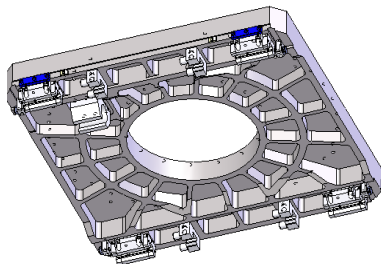
Positioning system

The positioning system is based on two plates supported by linear guideways. The system allows ± 25 mm on each direction. It includes pneumatic blocking system, positioning sensors and drives (AUXHI TRAC600660).

Drive Unit



Base plate

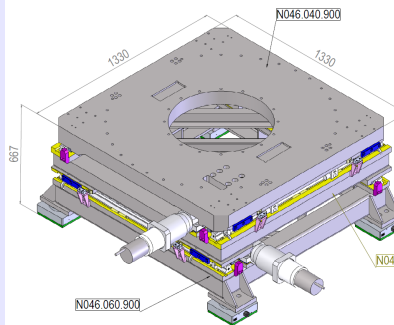


Drive Unit & Positioning system

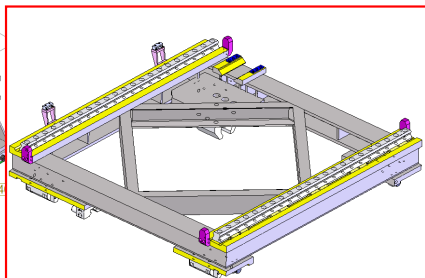
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Drive Unit



Guideways

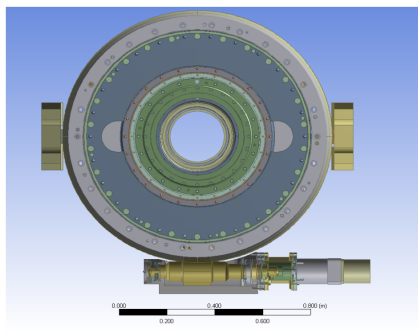
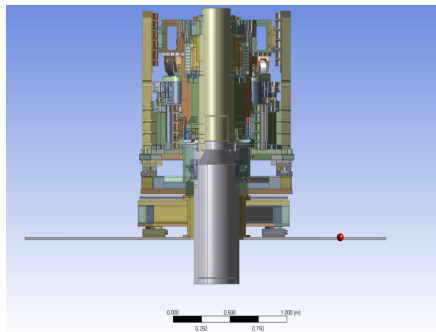


Drive Unit & Positioning system

Activation analysis

A complete damage and activation analysis has been performed to evaluate the life time and the handling operation of the drive unit.

Drive Unit mcnp model

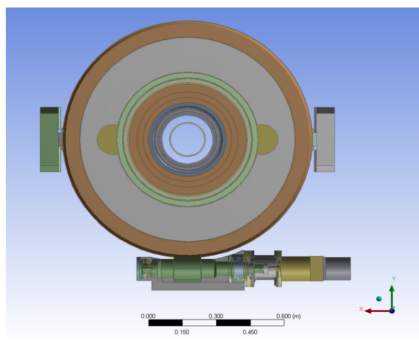
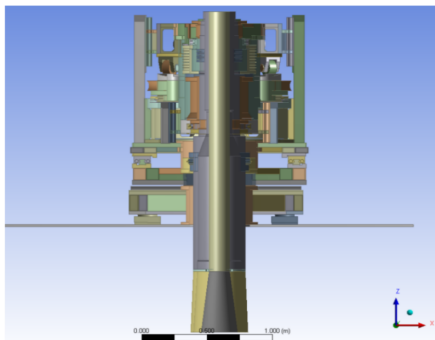


Drive Unit & Positioning system

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Drive Unit mcnp model



Drive Unit & Positioning system

Activation analysis

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Drive Unit decay radiation 1 hour after the shutdown



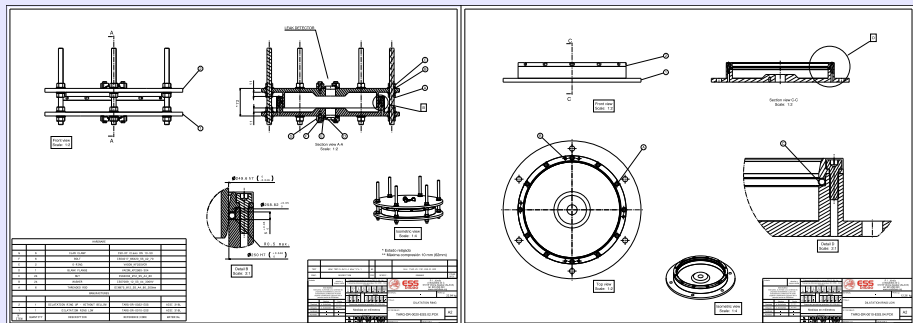
Shaft seals

Shaft and shielding

Seal between Shaft and Target Wheel

The Shaft will be flange to the Target wheel hence a seal system (on radiation environment) is needed to close the internal outlet pipe. The actual design criteria for total internal bypass is 3 gs^{-1} . We proposed a metallic seal (stainless steel and silver) in a configuration that allows vertical movement of the shaft. However, an EDD is needed.

Manufacturing prototype for seal concept



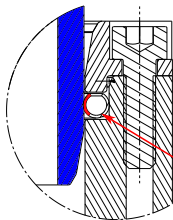
Shaft and shielding

Seal between Shaft and Target Wheel

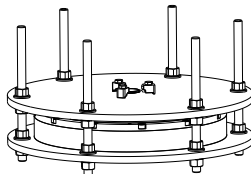
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Manufacturing prototype for seal concept

Inner shaft



Metallic Seal



Isometric view
Scale: 1:4

* Estado relajado

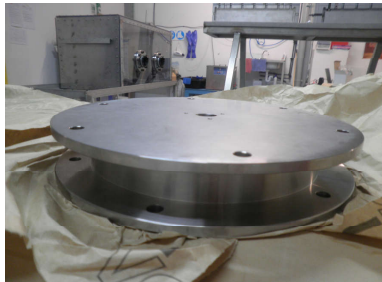
** Máxima compresión 10 mm (62mm)

Shaft and shielding

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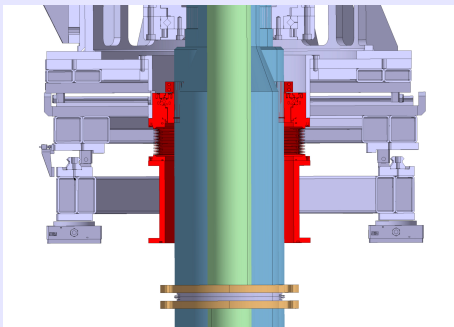


Shaft and shielding

Shaft total length

The total length of the Target system is far above 6.3 m (limit for handling in the hot cell). This means that the shaft have to be split it two peaces. This second connection will need and additional seal.

Flange connection below Drive Unit

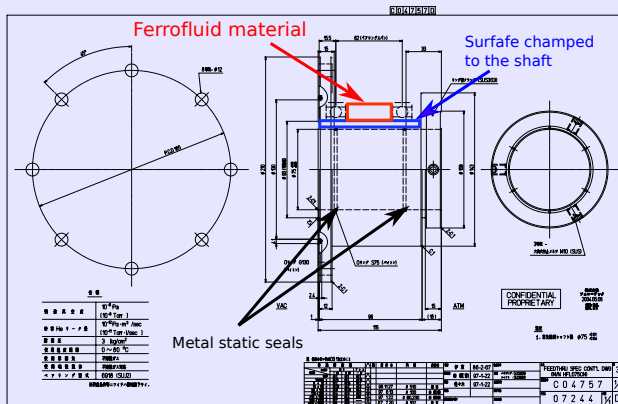


Shaft and shielding

Commercial product: Ferrofluid seal

The seal is a commercial product based on Ferrofluid technology. It includes a below in order to accommodate monolith vessel deformation and target shaft movement.

Rotating seal between shaft and monolith vessel



Rotating Seal

Conclusions

On going works

- Conceptual designs has been completed for the drive unit and the rotating seal.
- Contract has been award to A.V.S. for the detail design, manufacturing and testing of the Drive Unit module
- Prototyping activities associated to the internal shaft seals will be completed in the coming months.
- Rotating seals has been identify as industrial products. Public call for tender is on preparation.