



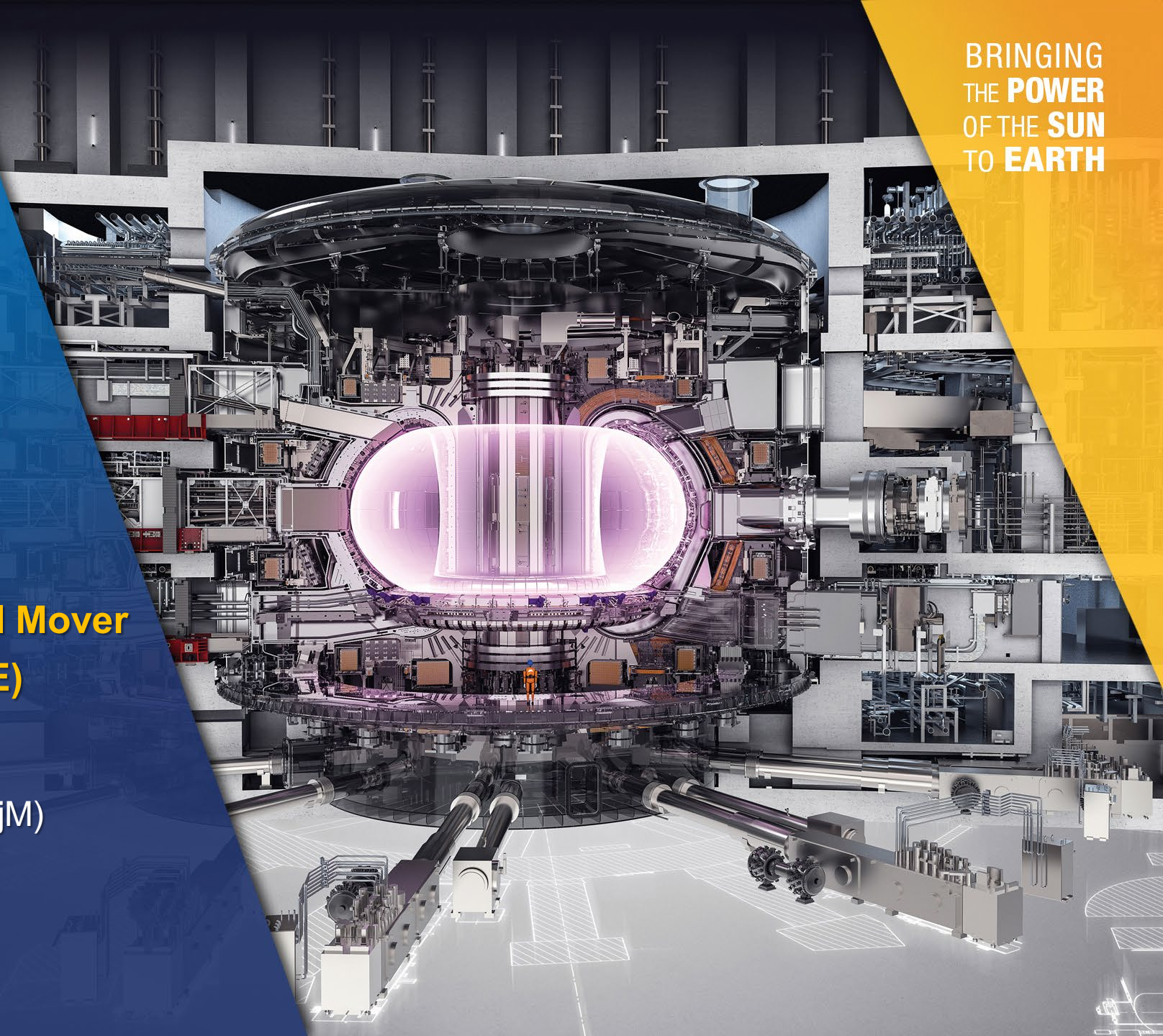
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**Technical Presentation
DAT Cassette Multifunctional Mover
(CMM) And End Effectors (EE)**

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F4E-OMF-1609 Info Day
November 5, 2024



DAT CMM: Introduction/ top level functions

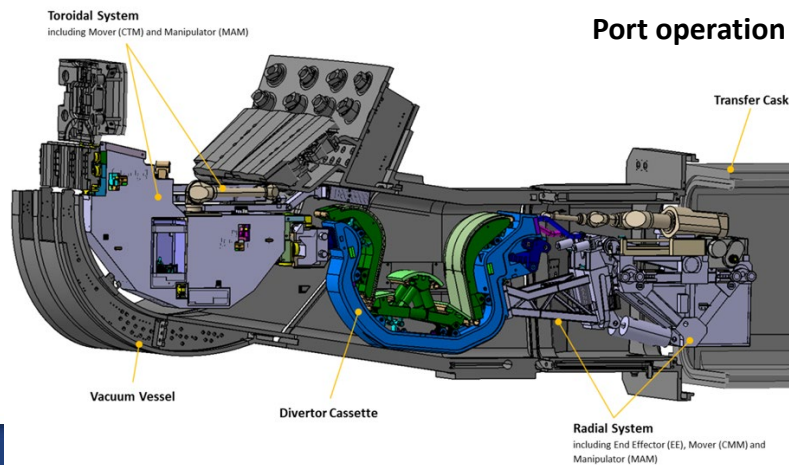
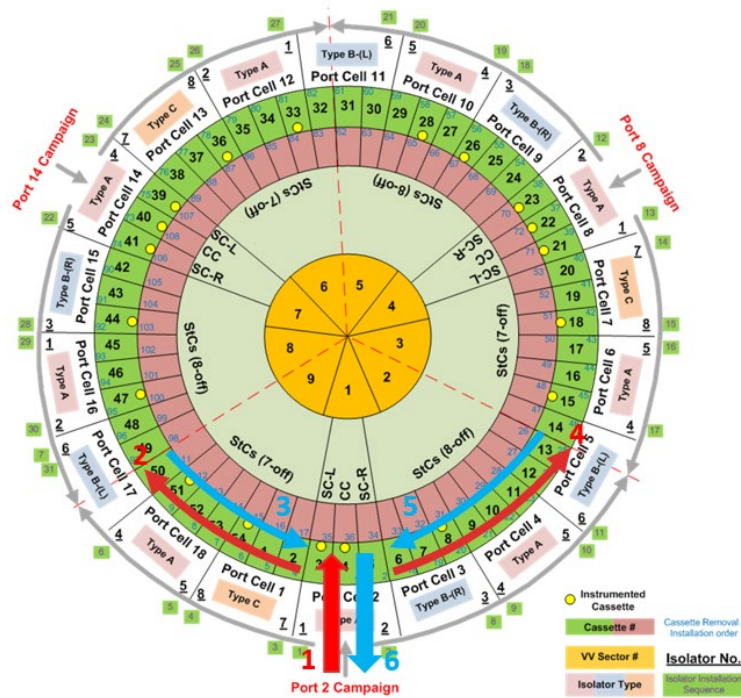
There is an existing Final Design of the of the nuclear grade CMM and End-Effectors (EE).

The DAT versions are simplified compared to these nuclear grade units as less functions are necessary. These simplifications are on-going, what is presented here is the current picture.

DAT top functions within each port campaign:

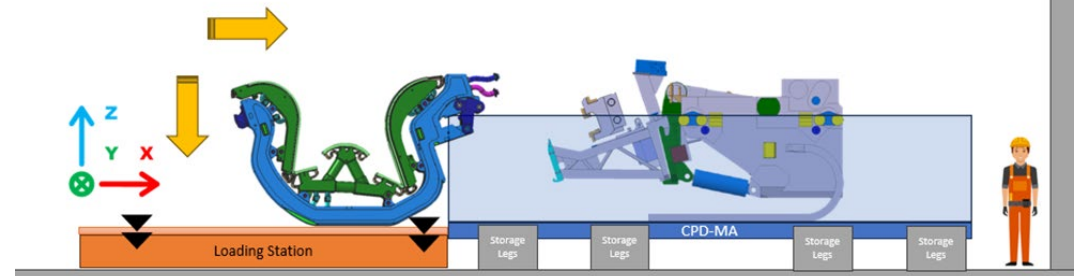
- Instal CTMs
- Deliver Standard cassettes to the CTM
- Install 1 second cassette
 - Operate the Cassette Locking System to lock the CC
- Install Diagnostic Rack

For each of these functions there is a corresponding pick-up component function in the assembly hall

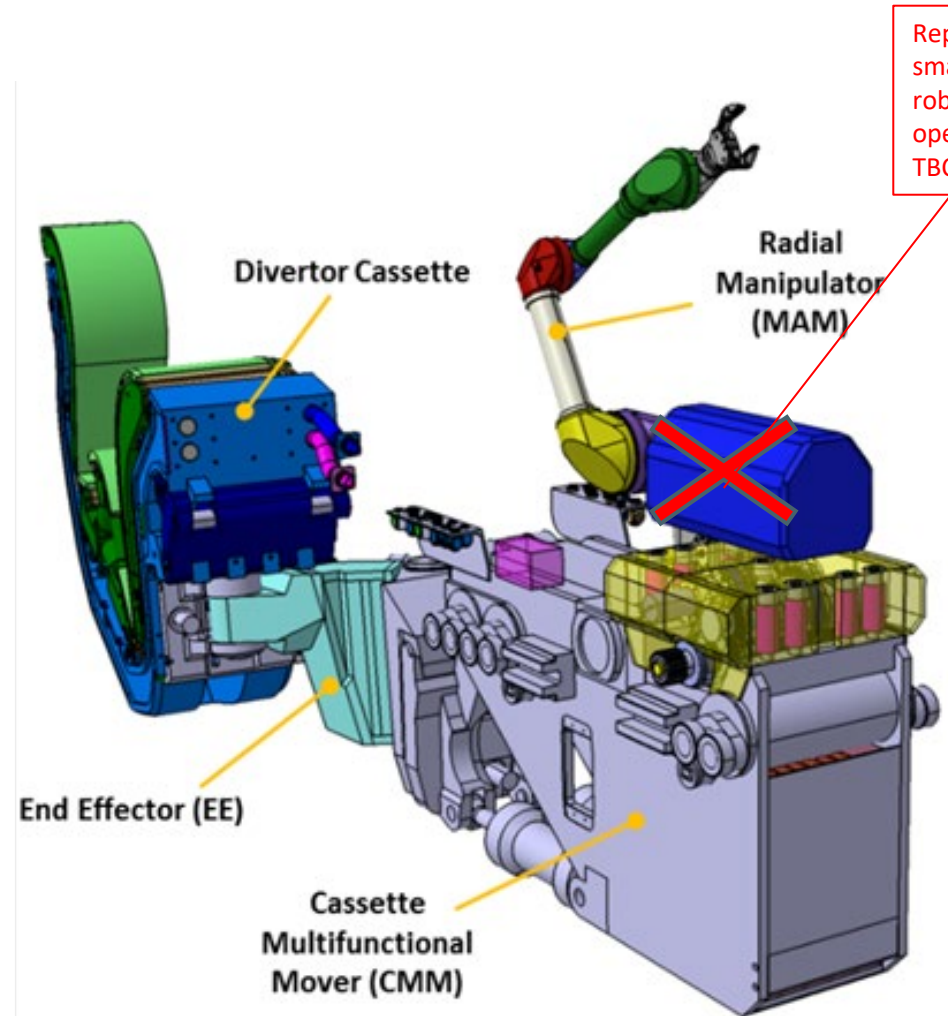
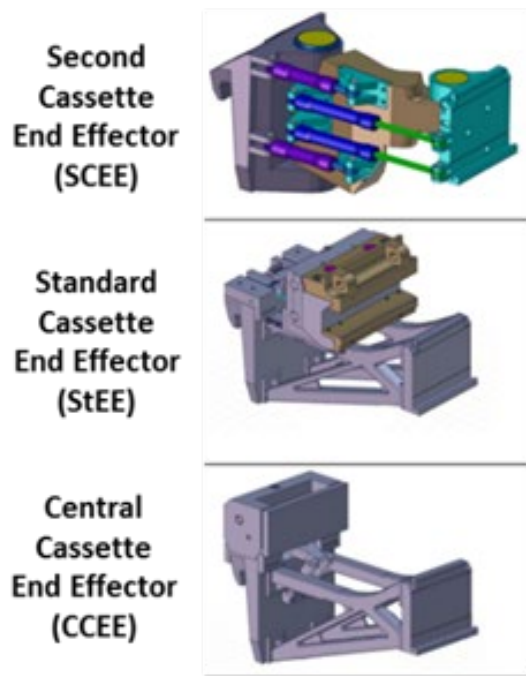


Port operation

Component pick up in ITER Assembly Hall

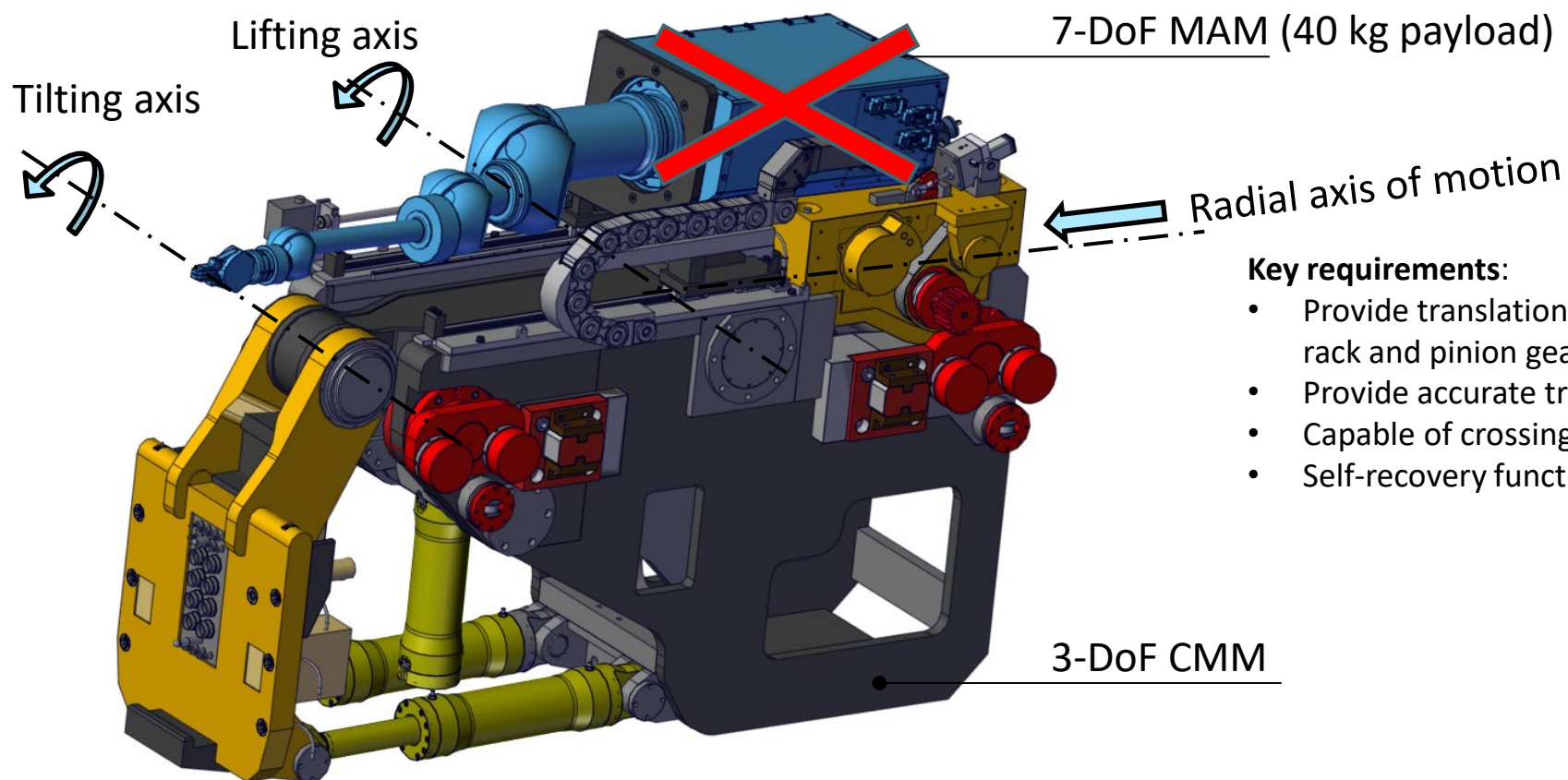


DAT CMM introduction/PBS



+ Hydraulic Power Unit (HPU),
+ Cable Chain not represented

Simplification options available and under assessment



Key requirements:

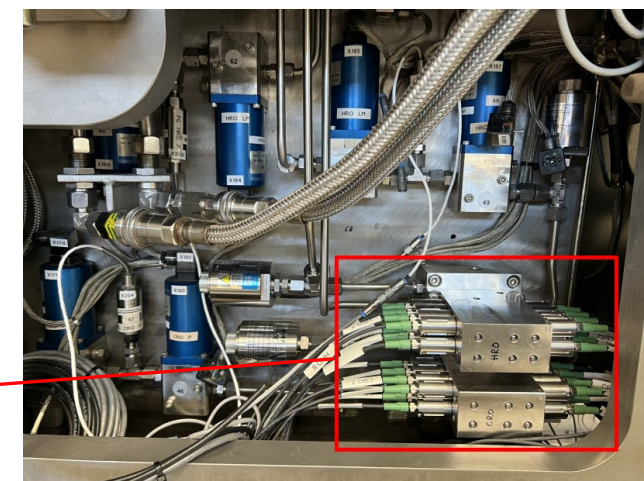
- Provide translational movement along Port Rails through a rack and pinion gear
- Provide accurate tracking position (± 1 mm)
- Capable of crossing rail gaps between Cask and Port rails
- Self-recovery functions and rescuable.

Key requirements lift and tilt:

- High power to size ratio due to limited space constraints
- Use of oil is forbidden
- Tracking accuracy (at cassette tip level) of ± 5 mm.

Design Implementation:

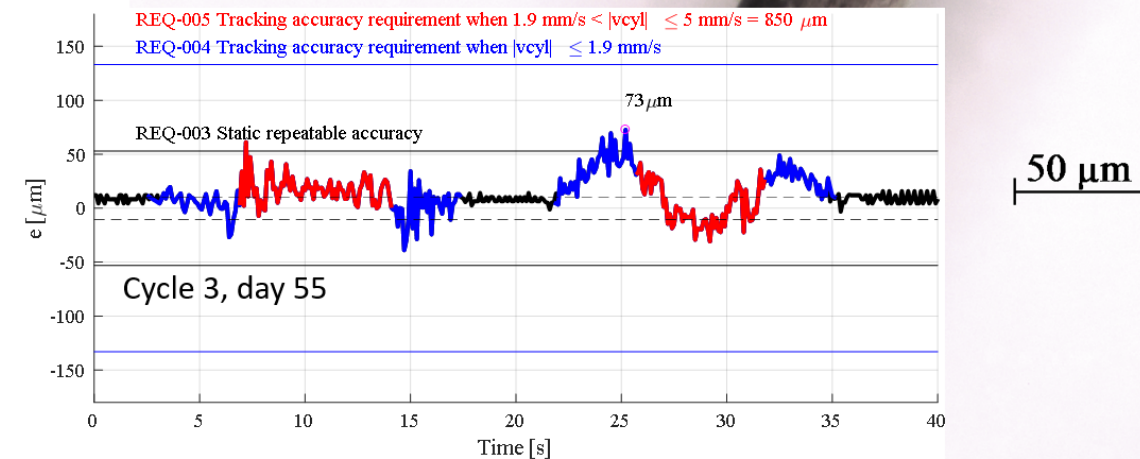
- Water-hydraulics servo-control system
- Technology choices: Digital valves developed and tested by F4E with VTT



How positioning accuracy is achieved:

- Use of water-hydraulic servo-control
- Use of hydraulic digital valves*:
 - Extremely fast response time: 1-2 ms
 - Tracking error = +/- 50 μm (DTP2 measurements)
 - Tracking error propagated to cylinder nose = +/- 3 mm
- Digital valve R&D program includes deployment on full scale CMM prototype on the DTP2 platform (VTT Finland)
- Radial drive are equipped with electric servomotors, low/zero backlash gearboxes and multi-speed resolvers. Providing a tracking accuracy of < 1 mm.

Seriously accurate tracking...

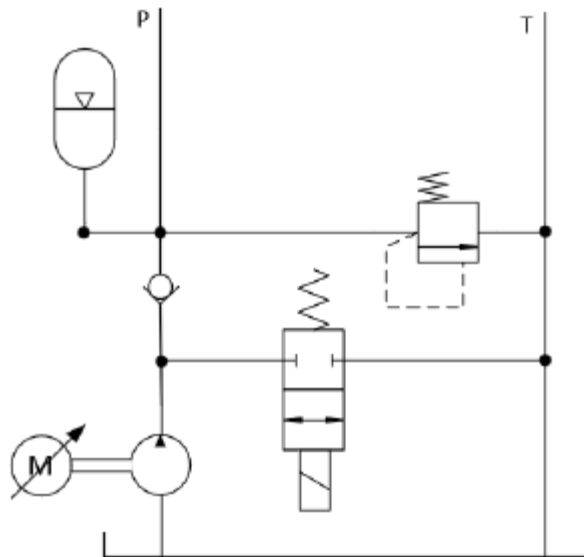


Microscopic imaging of a human hair

Tracking error measurements taken during digital valves tests at DTP2



Hydraulic Digital valve

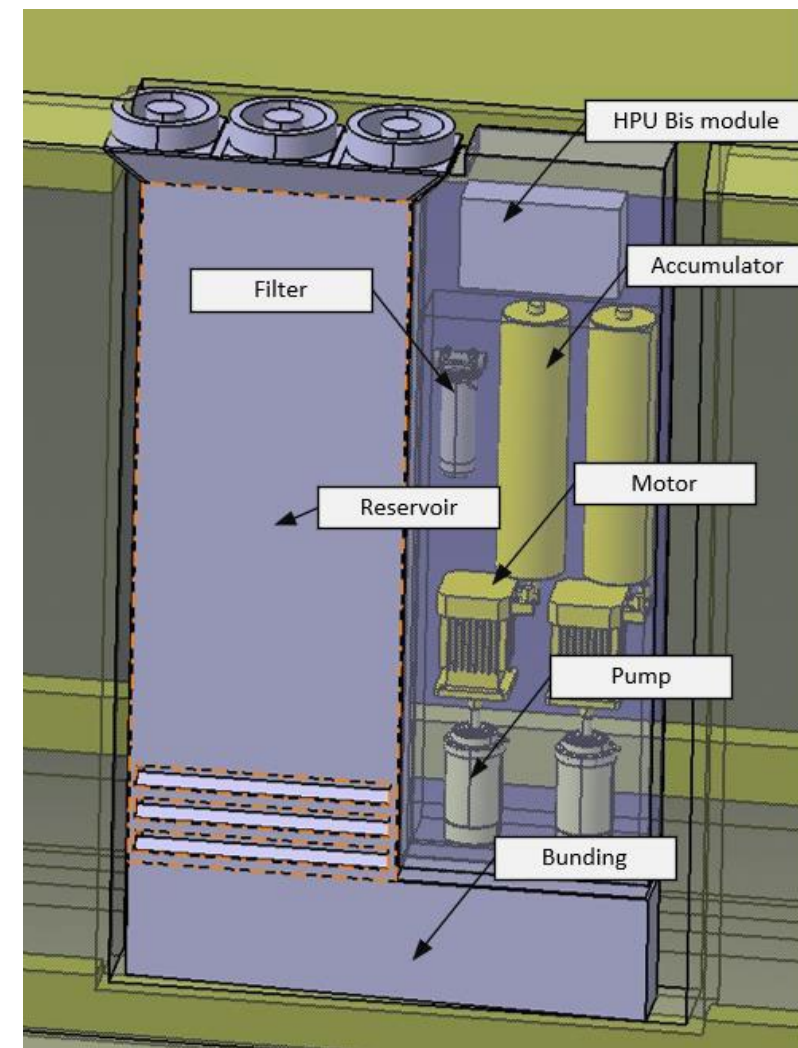


Key requirements:

- Ease of inspection and maintenance
- To be integrated in a reserved space on board the CPD
- Water temperature needs to be kept below 60-65 deg.
- Leak detection (below 1 litre) and safe-stop
- Supply pressure = 180 bar; Max. flow rate = 8 l/min.

Design Implementation:

- Selection of a 210 bar supply pump
- Excellent thermal efficiency based on a flow matching on-off charge pump concept:
 - Relies on the use of a large accumulator as the main flow source
 - Flow match is achieved since the accumulator provides the required flowrate automatically in real time



Main components of the HPU to be installed on board of the CPD

Example of End Effectors: the Central Cassette End-Effector

Central Cassette
Outboard Rail (CCOR)

Central Cassette End-Effector

Pre-loading Jack Unit
(PLU)

(1)

(2)

(3)

Support Pad

Hydraulic and Electrical
multi-connector

PLU

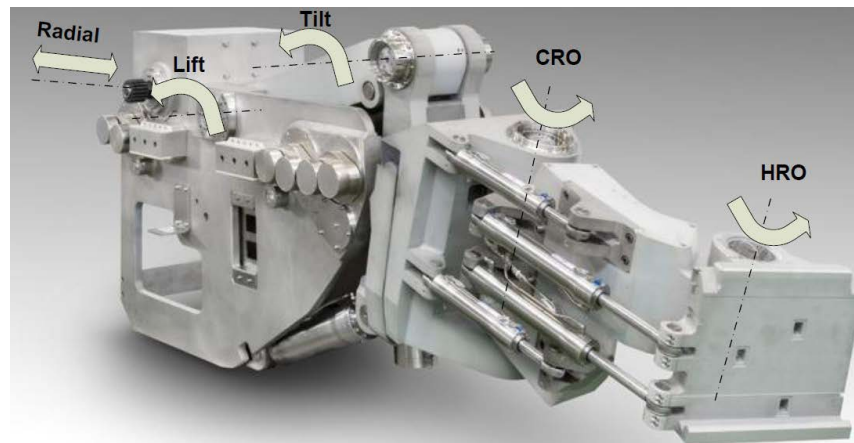
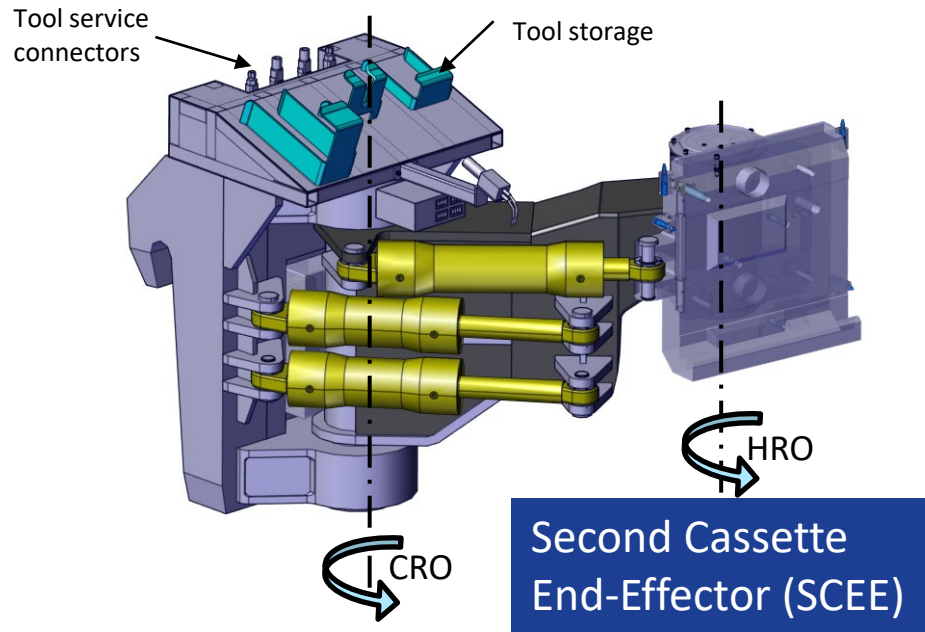
CMM locking feature
interface

Interface Plate

Key requirements:

- Transport and installation of Central Cassette
- CMM + CCEE to **align simultaneously 3 interfaces**
 - Cassette nose to in-vessel inboard interface (1)
 - CCOR pins to Divertor Support Pad (2)
 - Preloading Jack Unit pins to Support Pad (3)
- Provide a cassette compression force 150 kN
- Lock the compressed cassette to the Support Pad

Example of End Effectors: the Second Cassette End-Effector

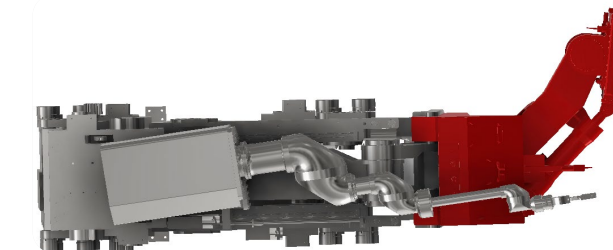
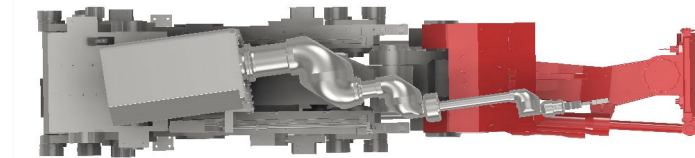


Key requirements:

- To provide positional adjustment in:
 - Toroidal (CRO)
 - Yaw (HRO)
- Interface plate to pick-up and drop cassettes

Design Implementation:

- Main bearing arrangements are double sealed and include dual-speed resolvers
- Bearings are able to accommodate 6 degree of axial misalignment when loading an off-centered cassette





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