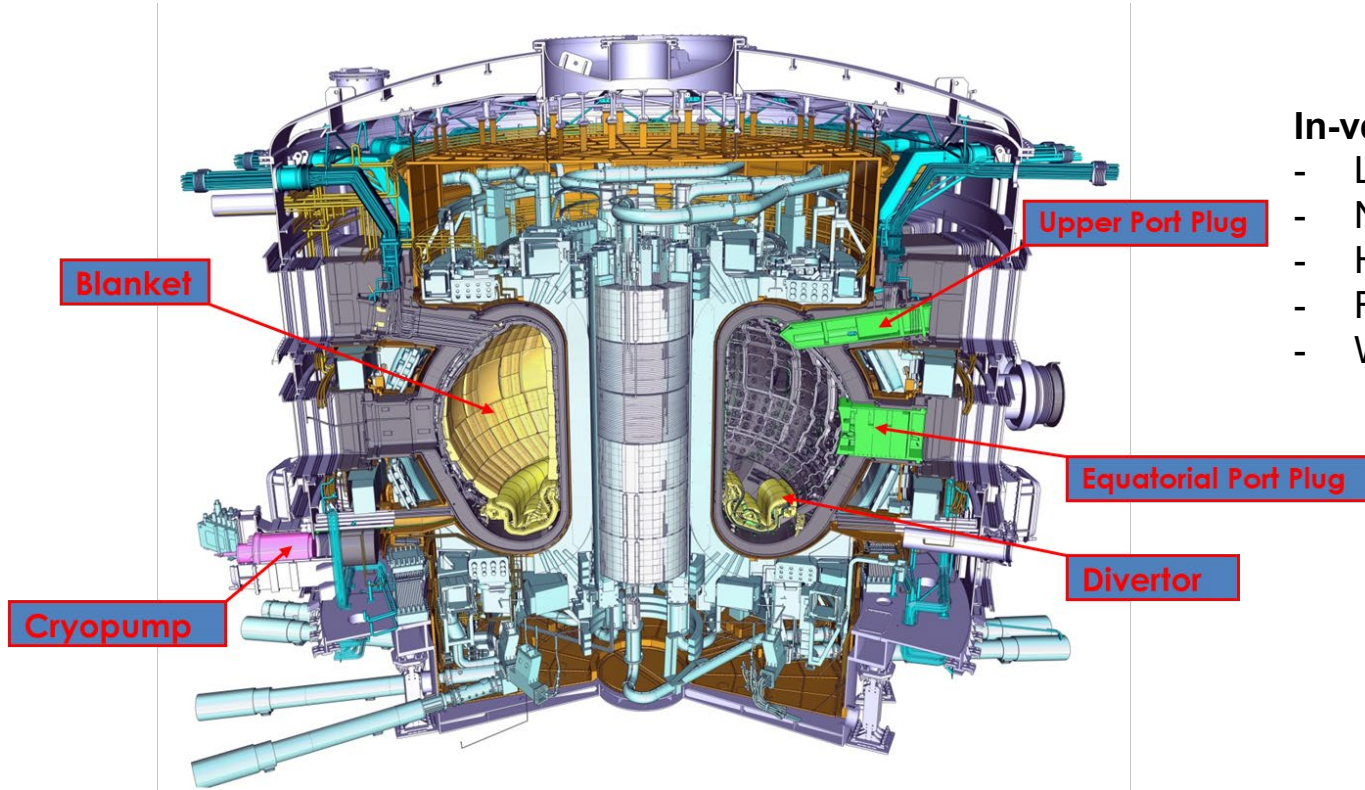


Meeting the ITER Remote Handling challenge

Jim Palmer
ITER Organization

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization

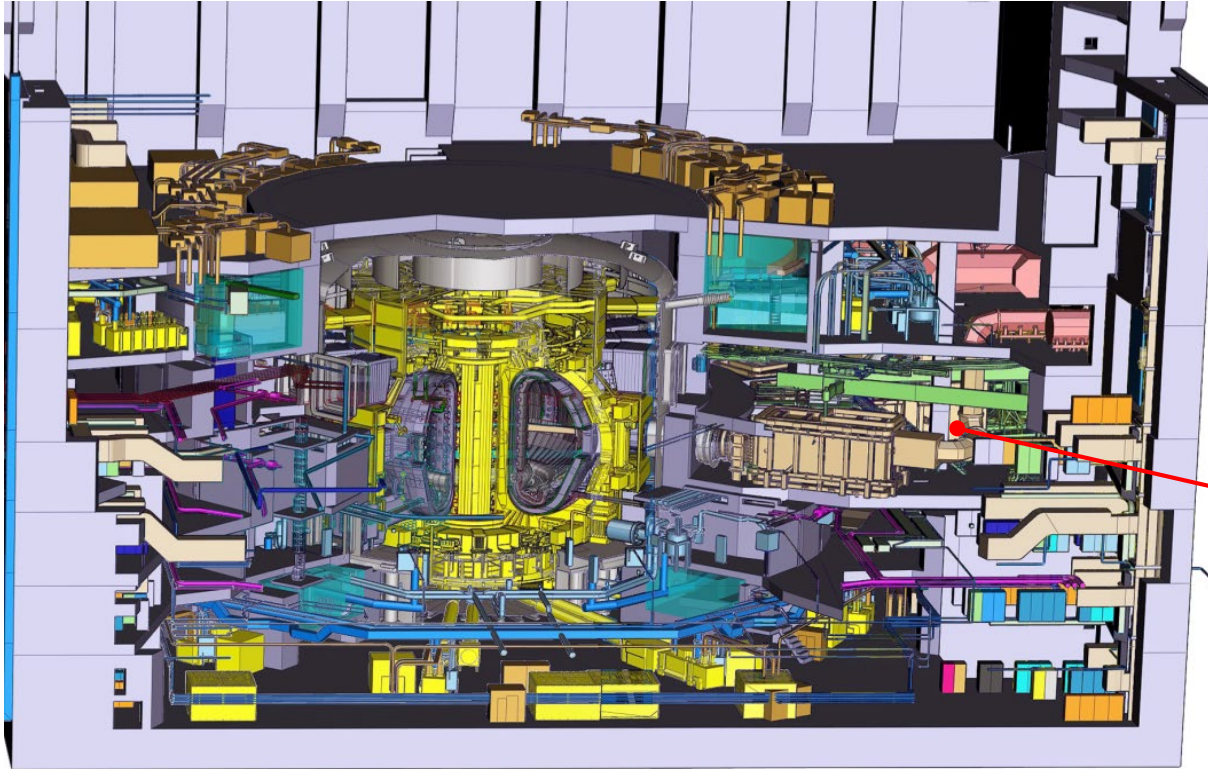
ITER Tokamak – maintainable elements



In-vessel RH Challenges:

- Large components (up to 48T)
- Narrow gaps (<10mm)
- High radiation (up to 500 Gy/hr)
- Radioactive & toxic dust (Be, W)
- Wide variety of components

ITER Tokamak – maintainable elements











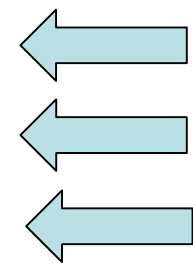
Neutral Beam RH Challenges:

- Large components (up to **20T**)
- Narrow gaps (<10mm)
- **Moderate radiation (mGy/hr)**
- Radioactive & toxic dust (Be, W)
- Wide variety of components

Neutral Beam
Cell

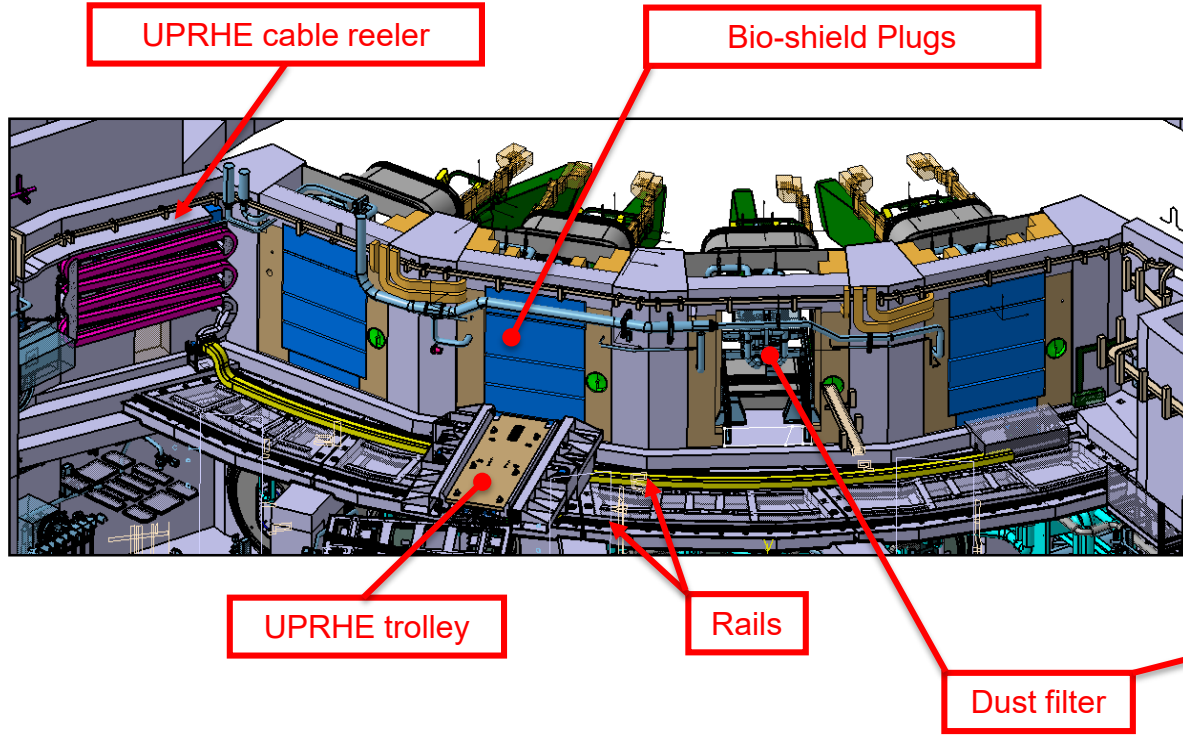
Procurement approach

RH System	Procurement Responsibility	Current Status
Blanket RH System		Final Design
Divertor RH System		Final Design
Cask and Plug Handling System		Preliminary Design
Neutral Beam RH System		Preliminary Design
RH Supervisory Control System		Delivered
NB cell upper port RH Equipment		Preliminary Design
VVPSS* RH System		Preliminary Design
Test Facilities and Mock-ups		Preliminary Design



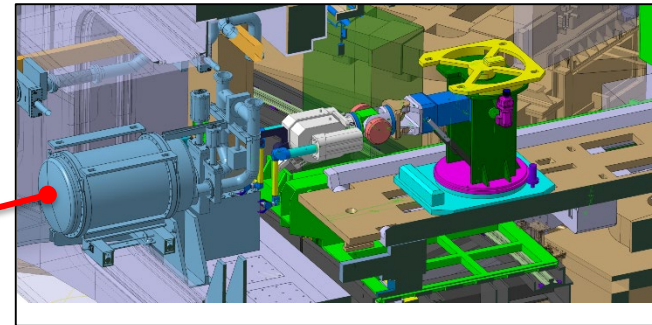
(* VVPSS = Vacuum Vessel Pressure Suppression System)

NB Cell Upper Port RH Equipment (UPRHE)

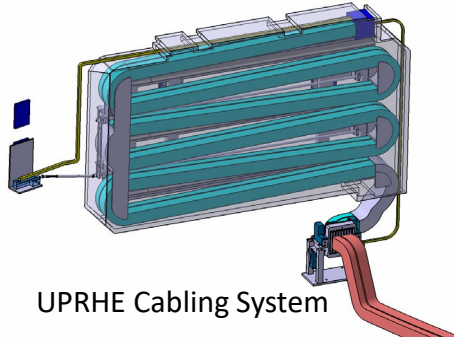


UPRHE main functions:

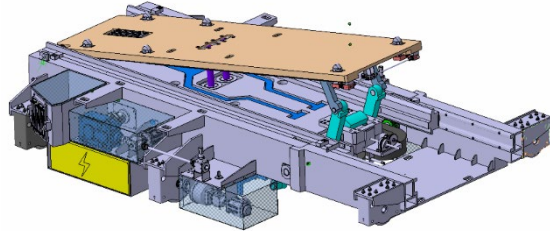
- To remove/replace bio-shield plugs
- To exchange vacuum system dust filters
- To exchange upper port plugs (unlikely event)



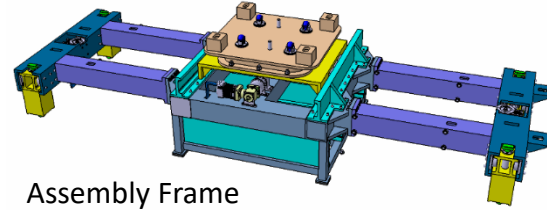
NB Cell Upper Port RH Equipment (UPRHE)



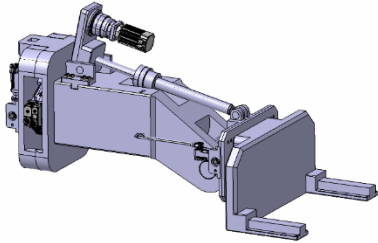
UPRHE Cabling System



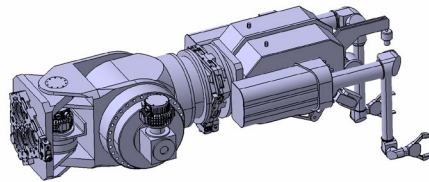
UPRHE Transporter



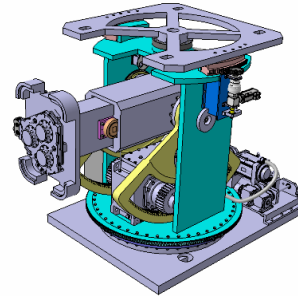
Assembly Frame



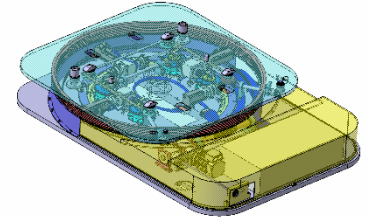
Bioshield Plug End Effector



Manipulator End Effector



Manipulator Transporter

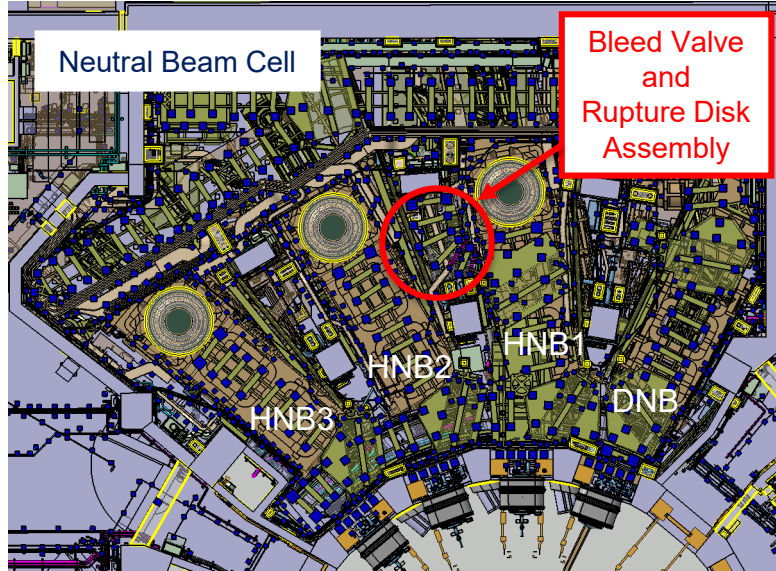


Filter Jacking tool

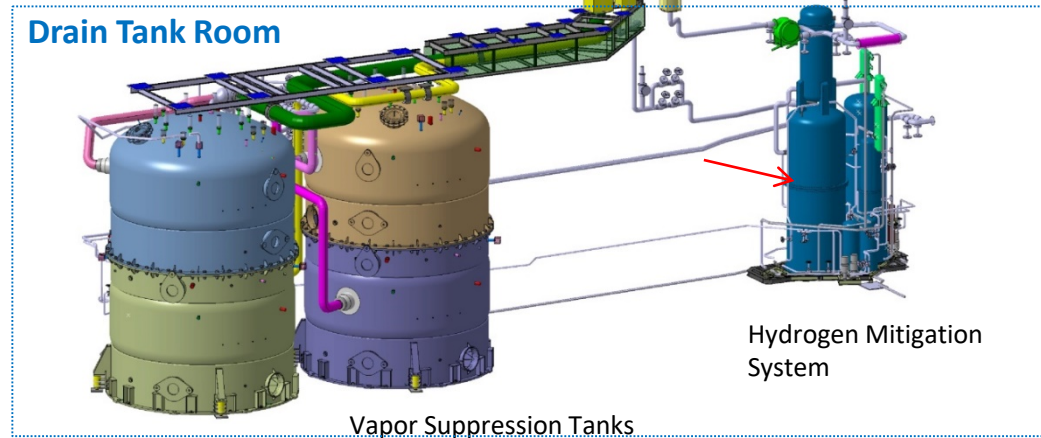
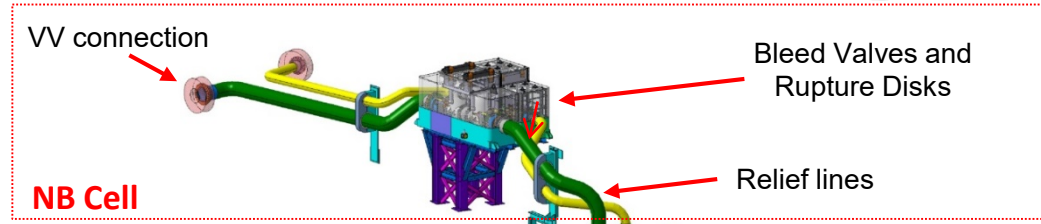
Procurement Process

- **Detailed design and manufacture** based on preliminary design (PD completed Sept-22)
- **International Tender 2025**

VVPSS RH System



HNB = Heating Neutral Beam
DNB = Diagnostic Neutral Beam



VVPSS RH System

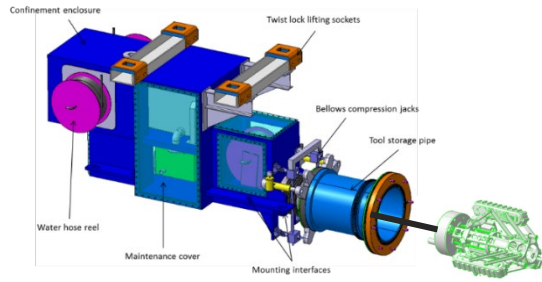
VVPSS RH system is for removal and replacement of the rupture disk assembly (scheduled maintenance) and bleed line valve assembly (corrective maintenance)

VVPSS RHE is composed of:

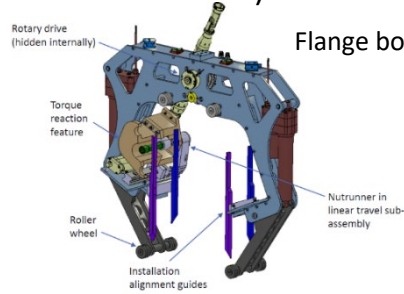
- Flange bolting tools
- Flange confinement tools
- Relief line cleaning tool
- Bellows compression tools

Procurement Process

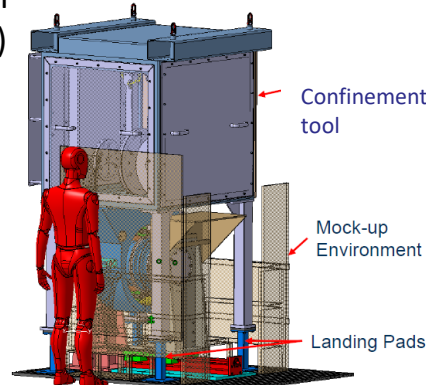
- **Detailed design and manufacture** based on preliminary design (PD completion Q4-23)
- **International Tender 2025**



Relief line cleaning tool

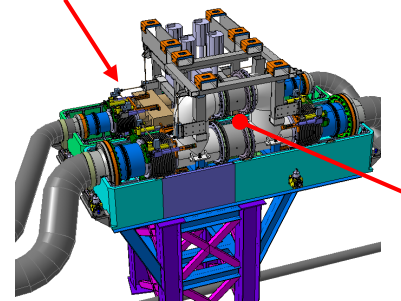


Flange bolting tool

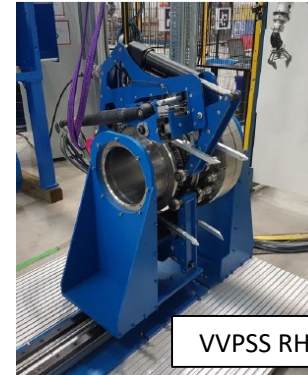


Flange confinement tool

Bleed Line Valve Assembly



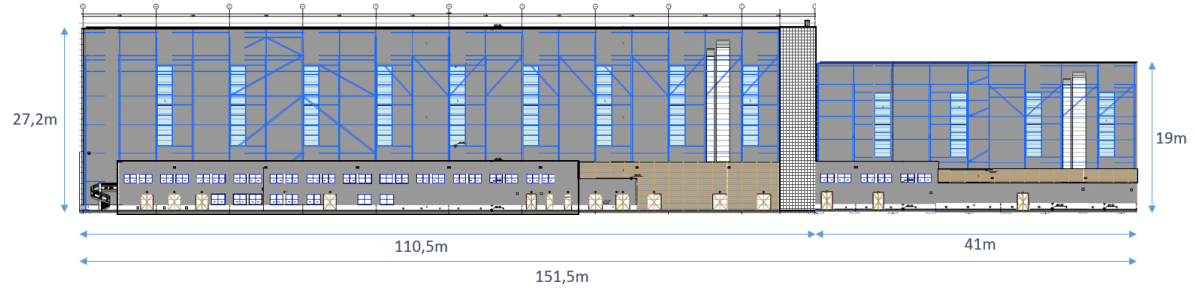
Rupture Disk Assembly



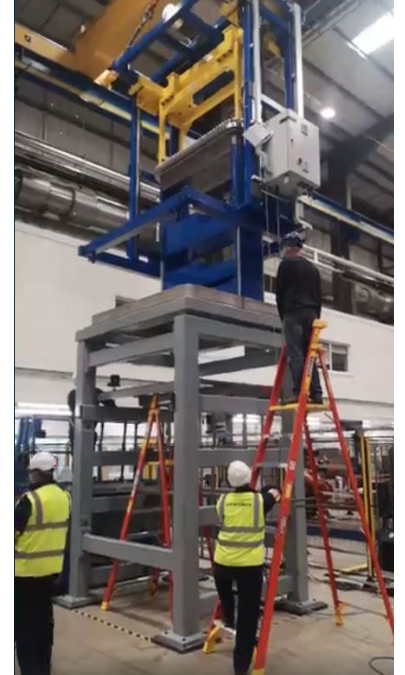
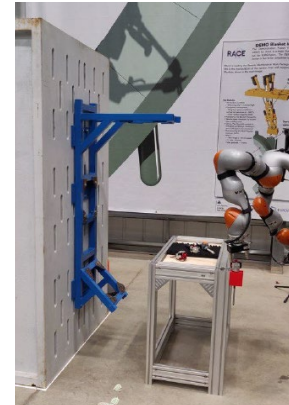
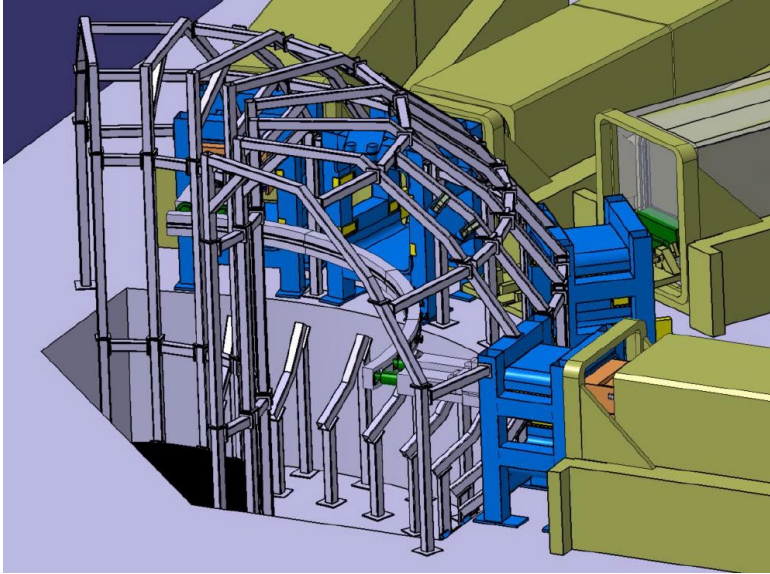
VVPSS RH prototypes

RH Test Facilities and Mock-ups

Overview of the ITER Maintenance Test Facility (IMTF)



RH Test Facilities and Mock-ups



Procurement Process

- **Detailed design and manufacture** based on preliminary design (PD completion Q4-23)
- **International Tenders starting 2025**

Conclusion

- Successful implementation of ITER Remote Handling is key to the successful implementation of ITER.
- The main challenges for ITER RH include:
 - Size and weight of in-vessel components combined with small clearances
 - Gamma radiation in the 100s of Gy/hour range
 - Presence of radioactive and toxic dust
- A number of **medium-term** opportunities (up to 2030) have been identified for the :
 - supply of RH systems and tooling (VVPSS RH, NB Cell Upper Port RH)
 - supply of test facilities and mock-ups
- ITER Remote Handling is a **long-term** project spanning ITER construction to ITER dismantling. Similar opportunities will exist in the longer term (beyond 2040).