

Construction of a Very Large Turret (VLT)

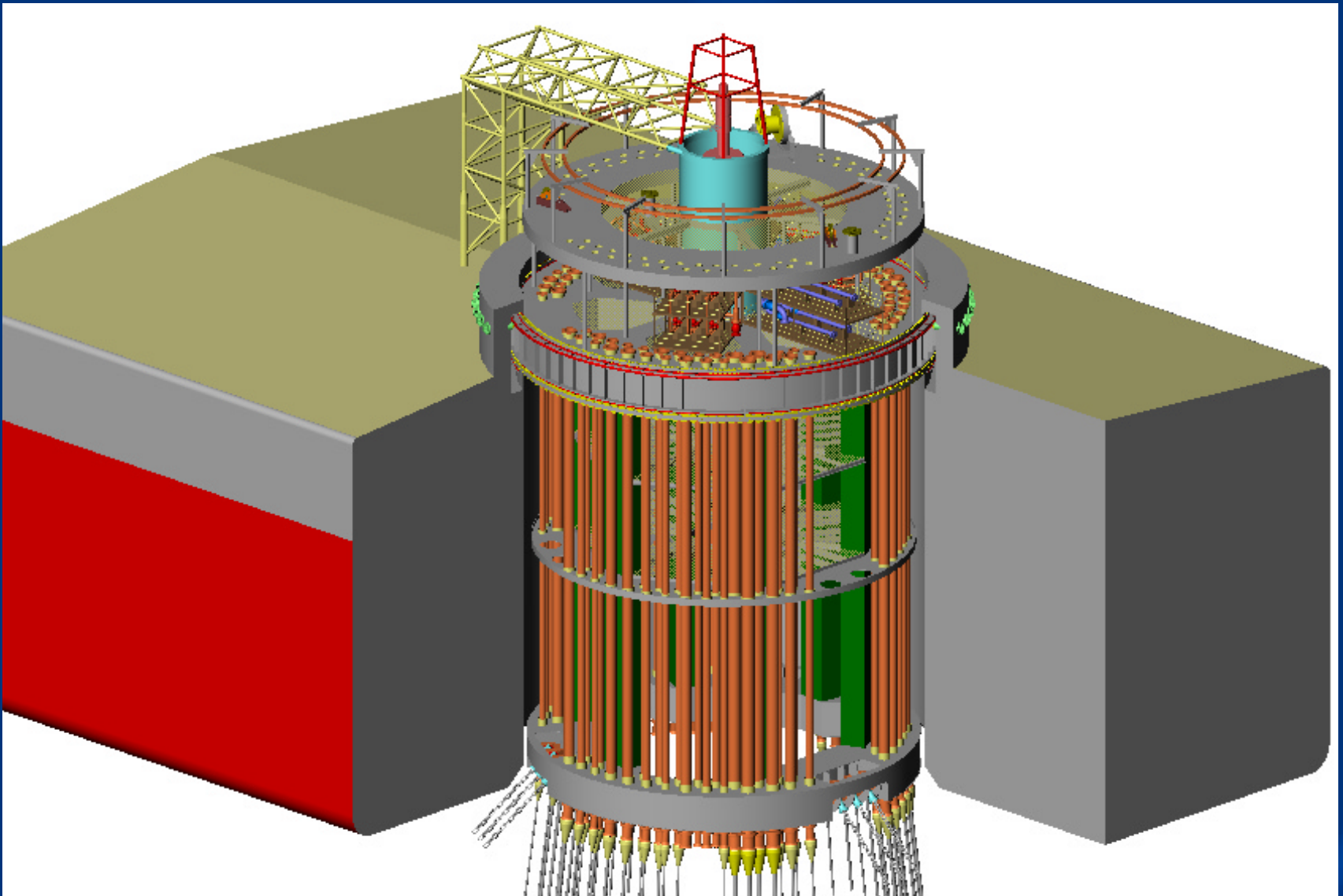
Marine Construction 2002

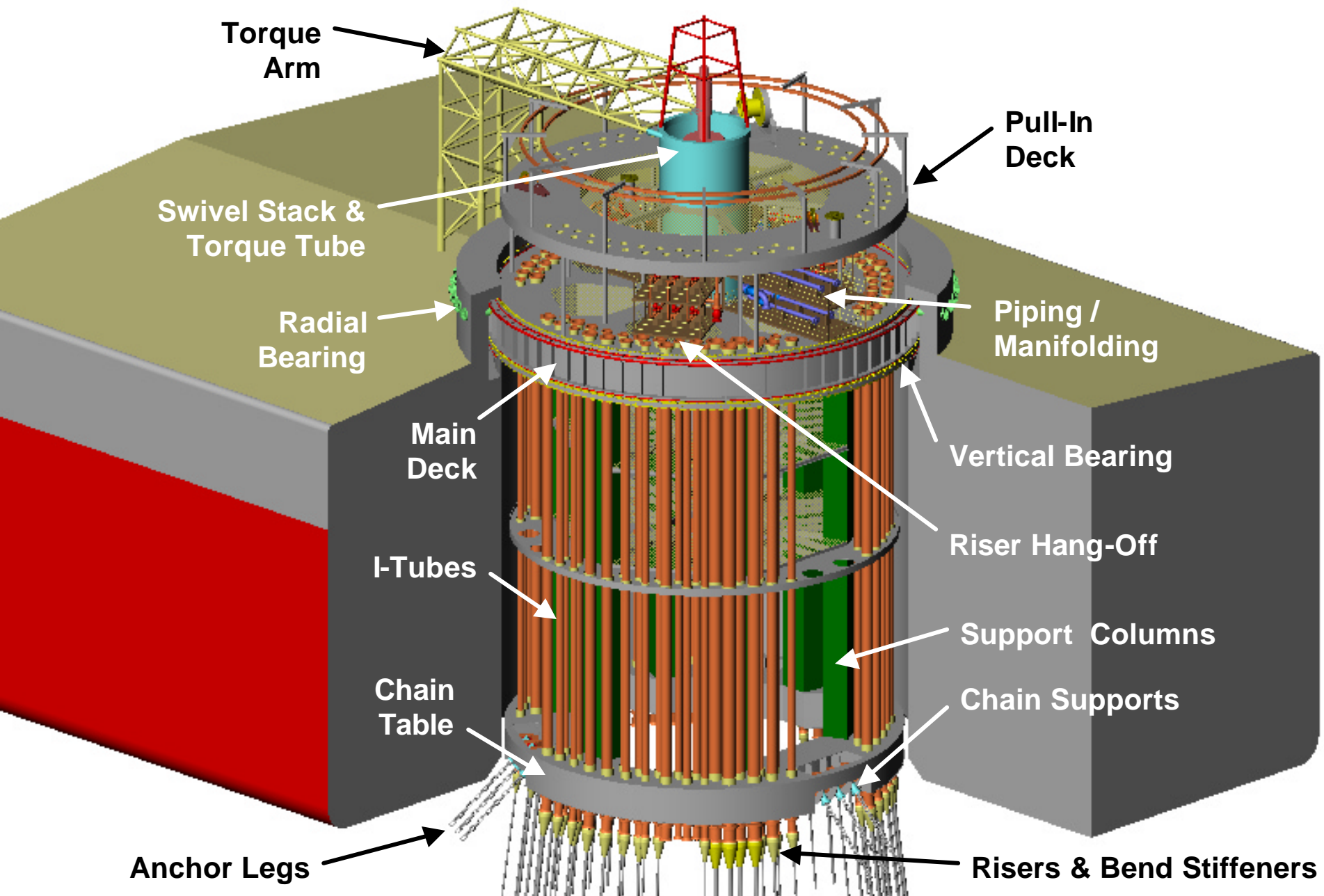
Charles Garnero
FMC SOFEC Floating Systems
7 February 2002

Design Features of the VLT

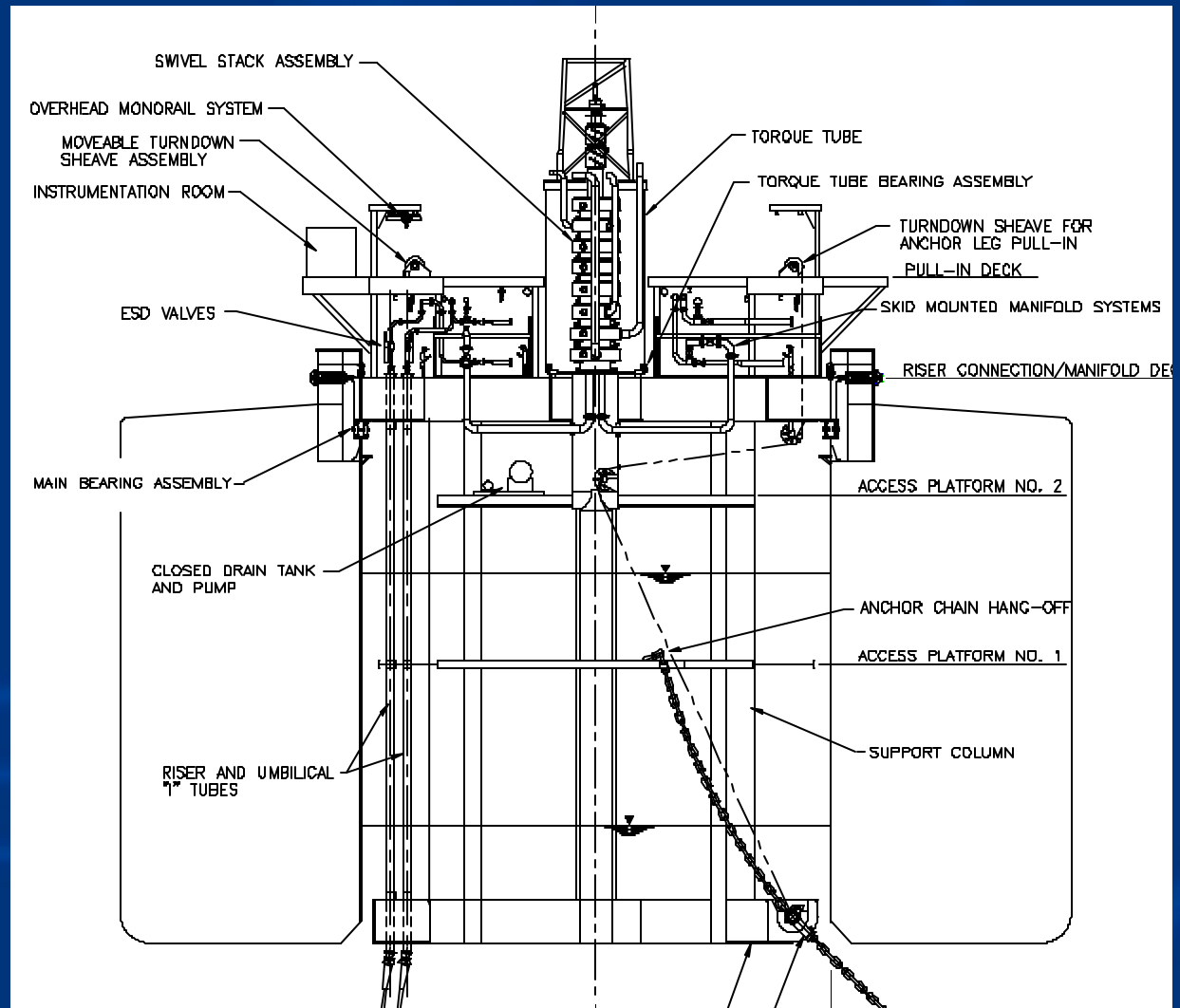
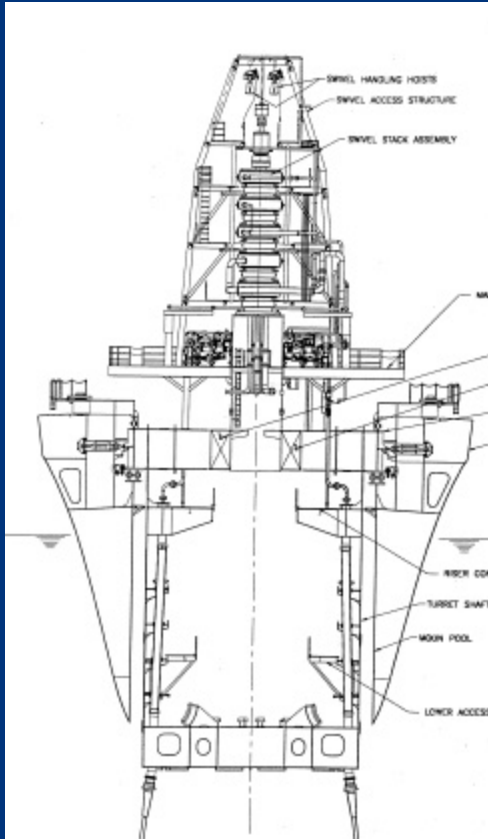
- **High riser capacity (100+ risers)**
- **Ultra deepwater FPSO applications**
- **Simplified turret structure**
- **Simplified bearing system**
- **Generous open space throughout turret**
- **Standardized riser slots for multiple riser sizes**
- **Compatible with both flexible and steel risers**

FMC SOFEC's Very Large Turret

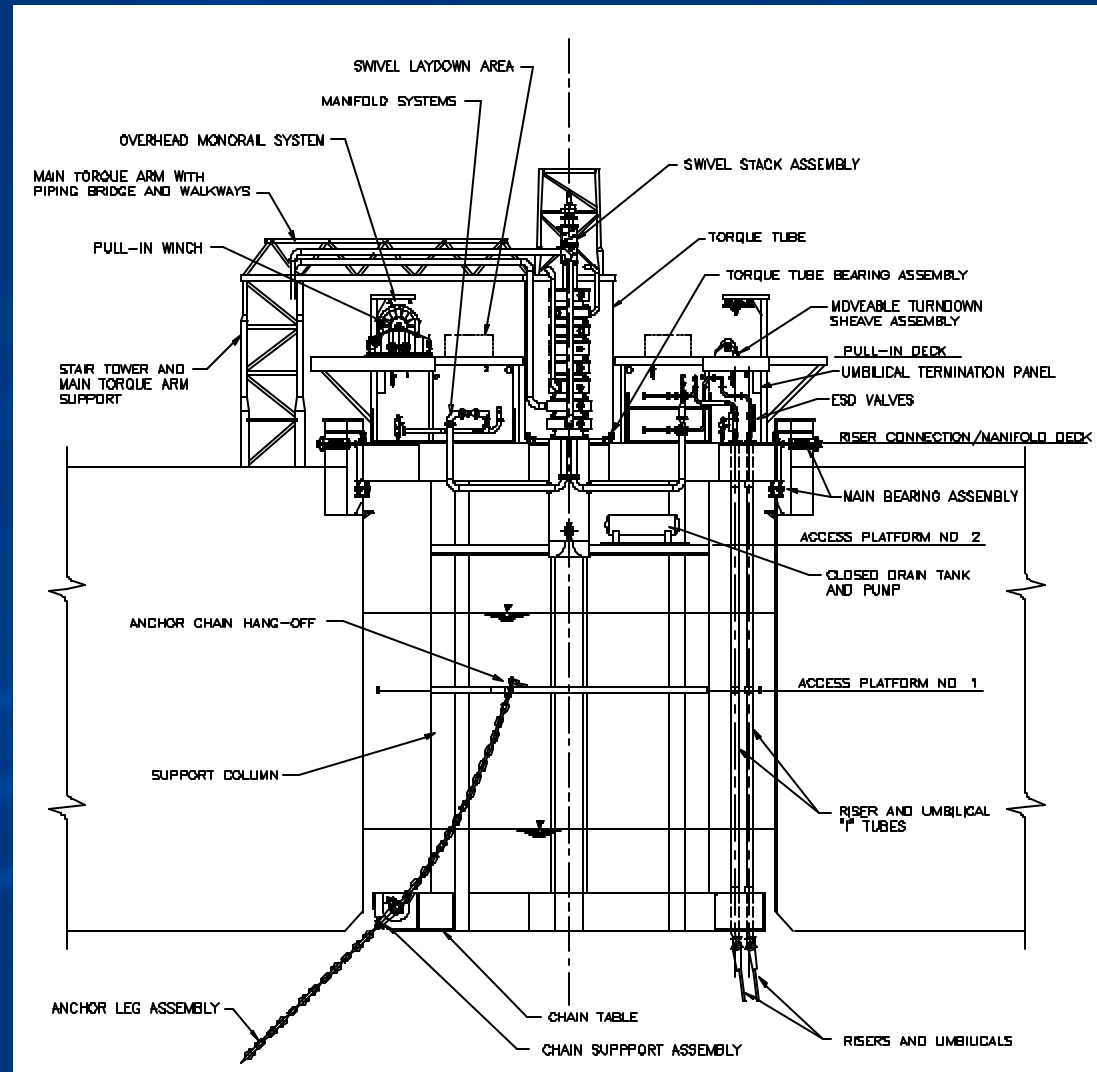
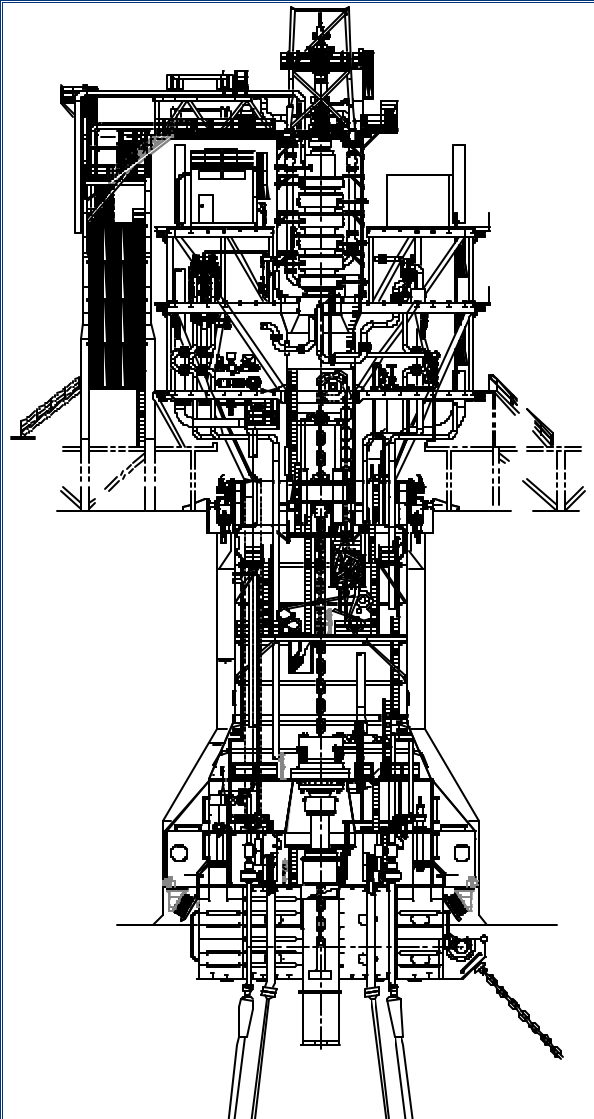




P-34 Barracuda and the VLT



Terra Nova and the VLT



VLT Turret Construction Objectives

- **Low cost simple construction**
- **Use proven construction methods**
- **Use available cranes (drydock and floating)**
- **Constructability in shipyards worldwide**
- **Minimum drydock time**

VLT Turret Construction Challenges

- **Structural frame weight: 3100 metric tons**
 - Main Deck 1700 tons
 - Columns 800 tons (6 @ 133 tons each)
 - Chain Table 600 tons
- **Machining**
 - Portable machining equipment
 - Machining accuracy at large diameters
- **Welding**
 - Distortion control
 - Thermal stress relief

Minimum Required Lift Capacities

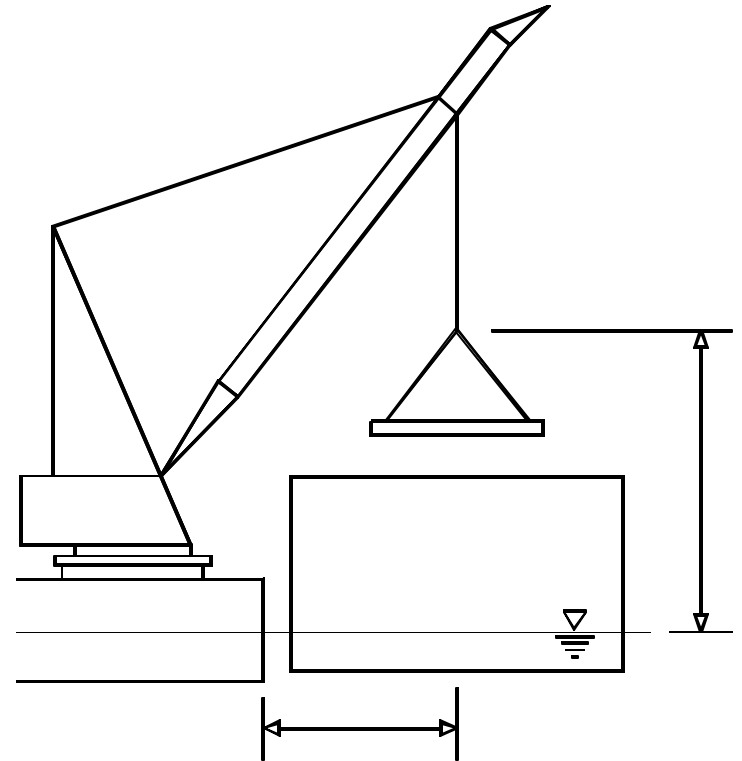
	Limited Lift	Heavy Lift
Reach	32 m	32 m
Hook Height	50 m	50 m
Drydock Lift	375 mt	600 mt
Floating Lift	160 mt	1700 mt
Drydock Time	3-5 months	1-2 months

Heavy Lift Vessels

Thiaf, S7000, Hermod, DB50, DB30

Heavy Lift Yards

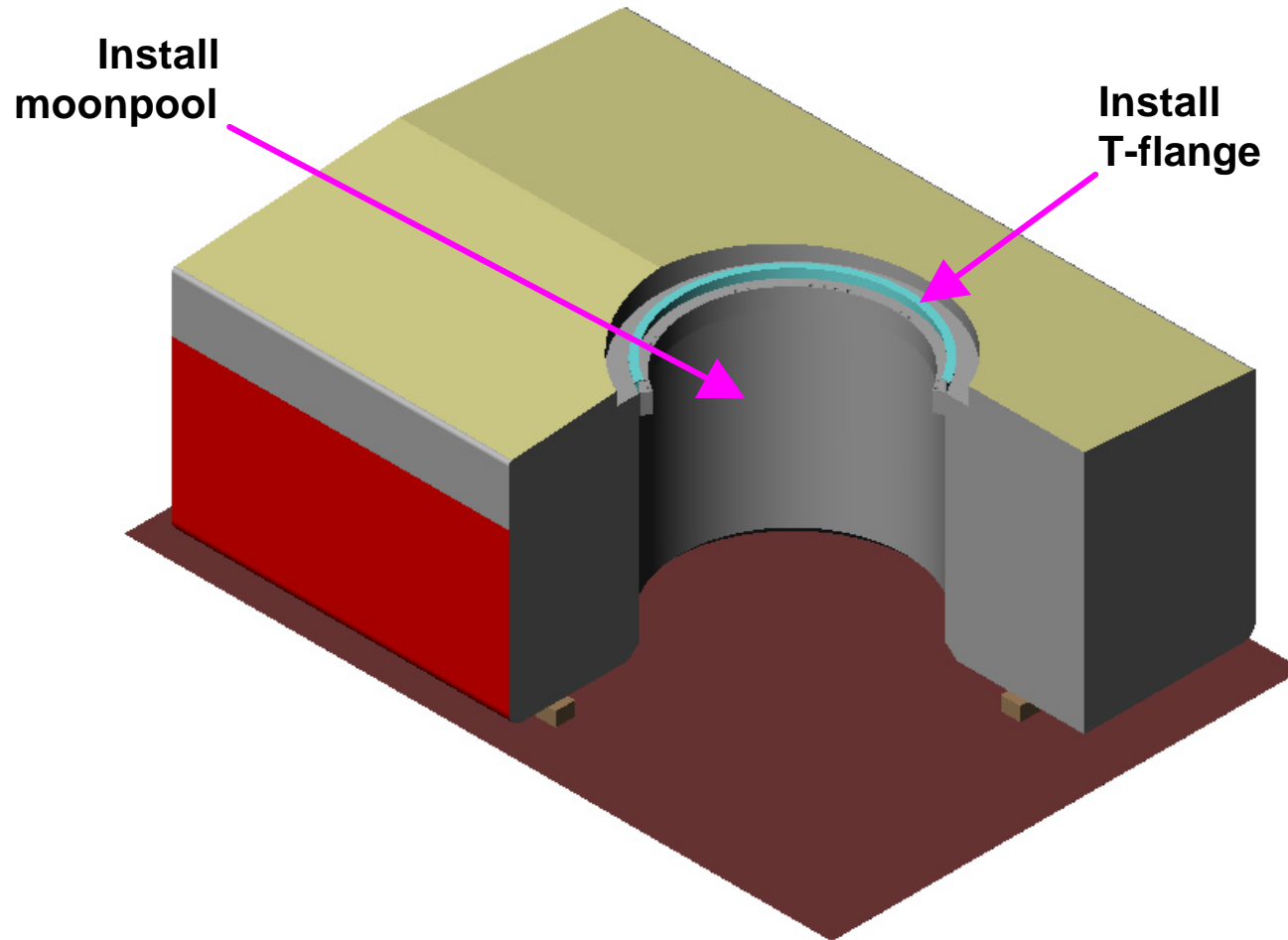
Malaysia (MSE Shipyard), Singapore (Far East Livingston, Keppel, Jurong), China (Yanti), Korea (Hyundai, Daewoo, Samsung)



VLT Turret Construction Sequence using Limited Lift Capacity Cranes

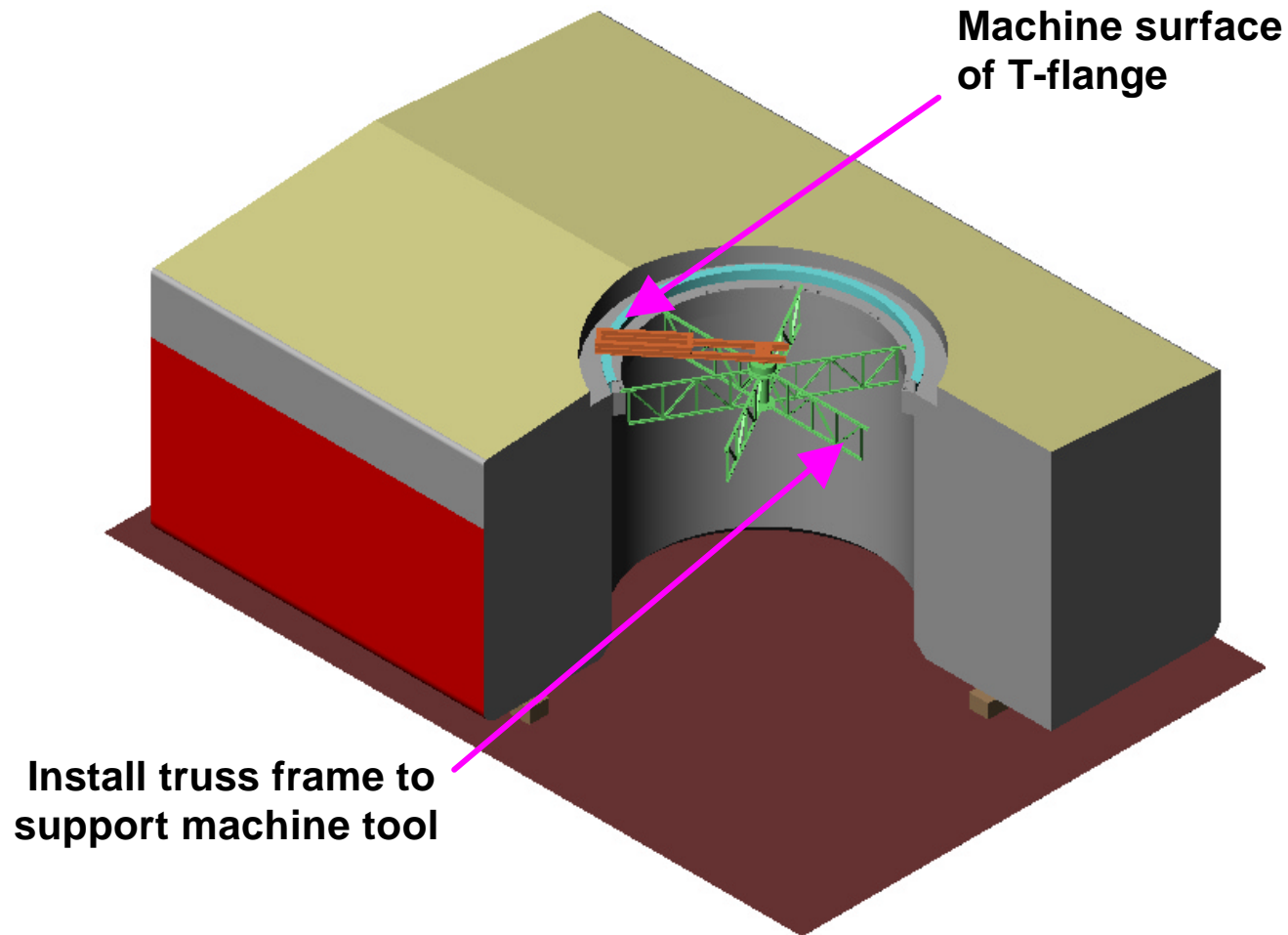
Limited Lift Construction - 1

Vessel floating or in drydock

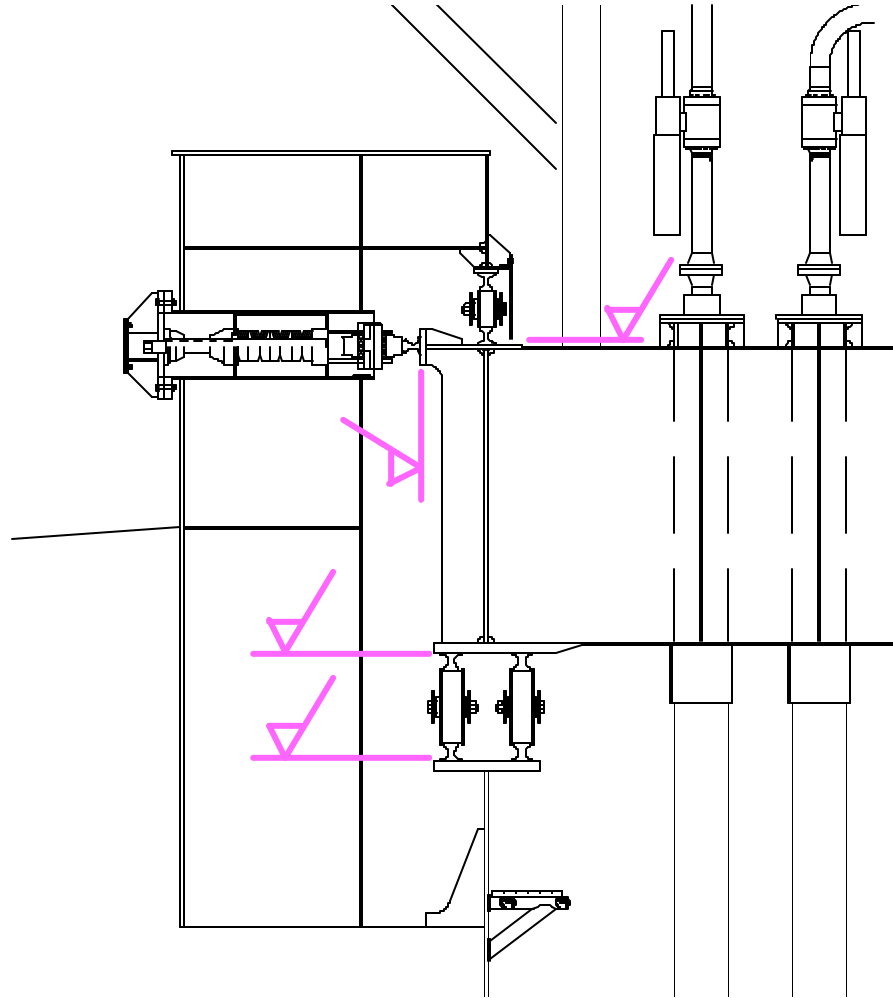


Limited Lift Construction - 2

Vessel floating or in drydock



VLT Bearing Surfaces Requiring Machining



Machining of Bearing Surfaces

EXTRA LARGE CIRCULAR SELF LEVELING MILL (XL-CSLM)

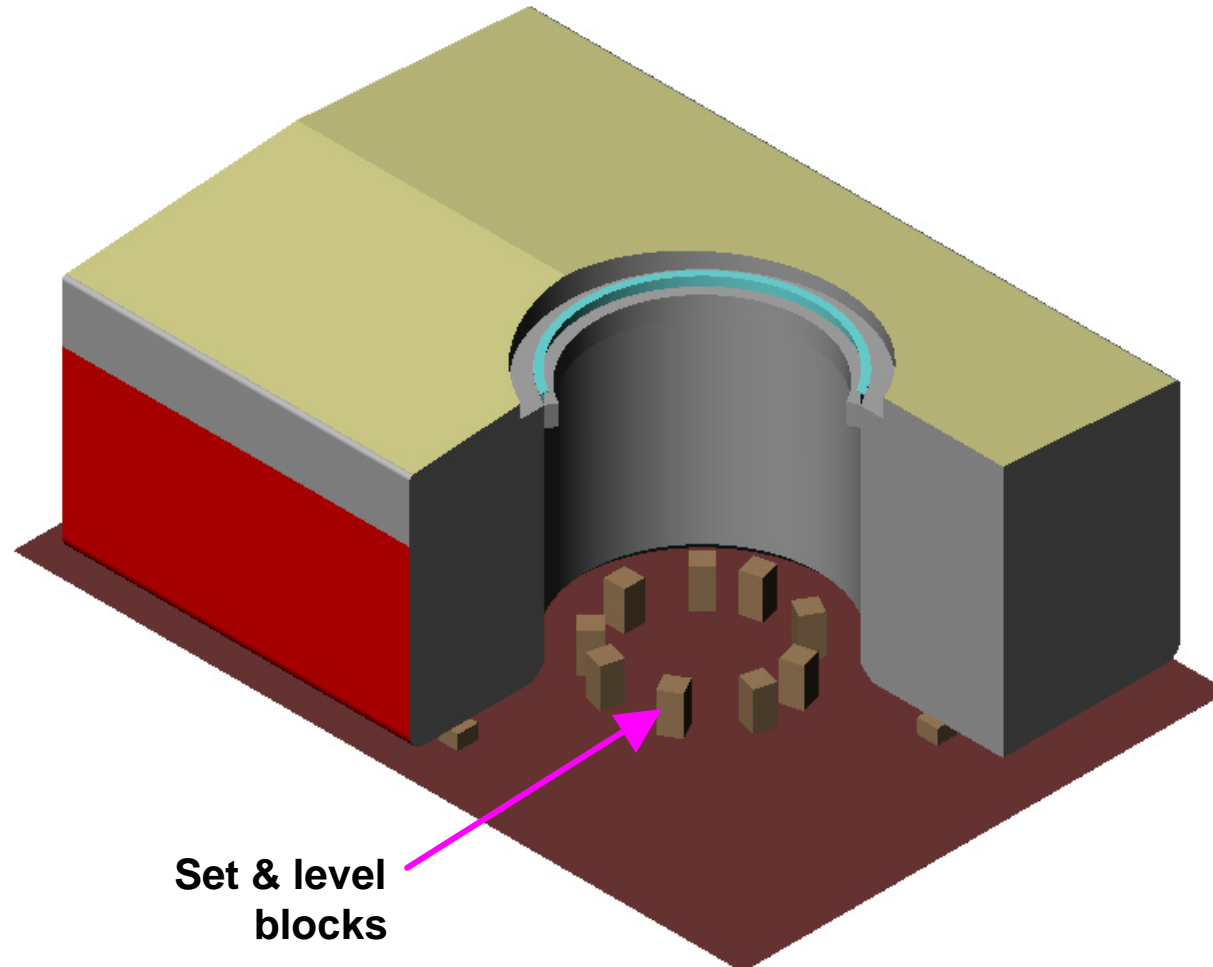


Above: XL-CSLM machining a ø85ft (26m) Crane base. Many factors influence the final machining tolerance such as thermal distortion and fabrication rigidity. In this instance a final flatness of 0.010" (0.25mm) was achieved.

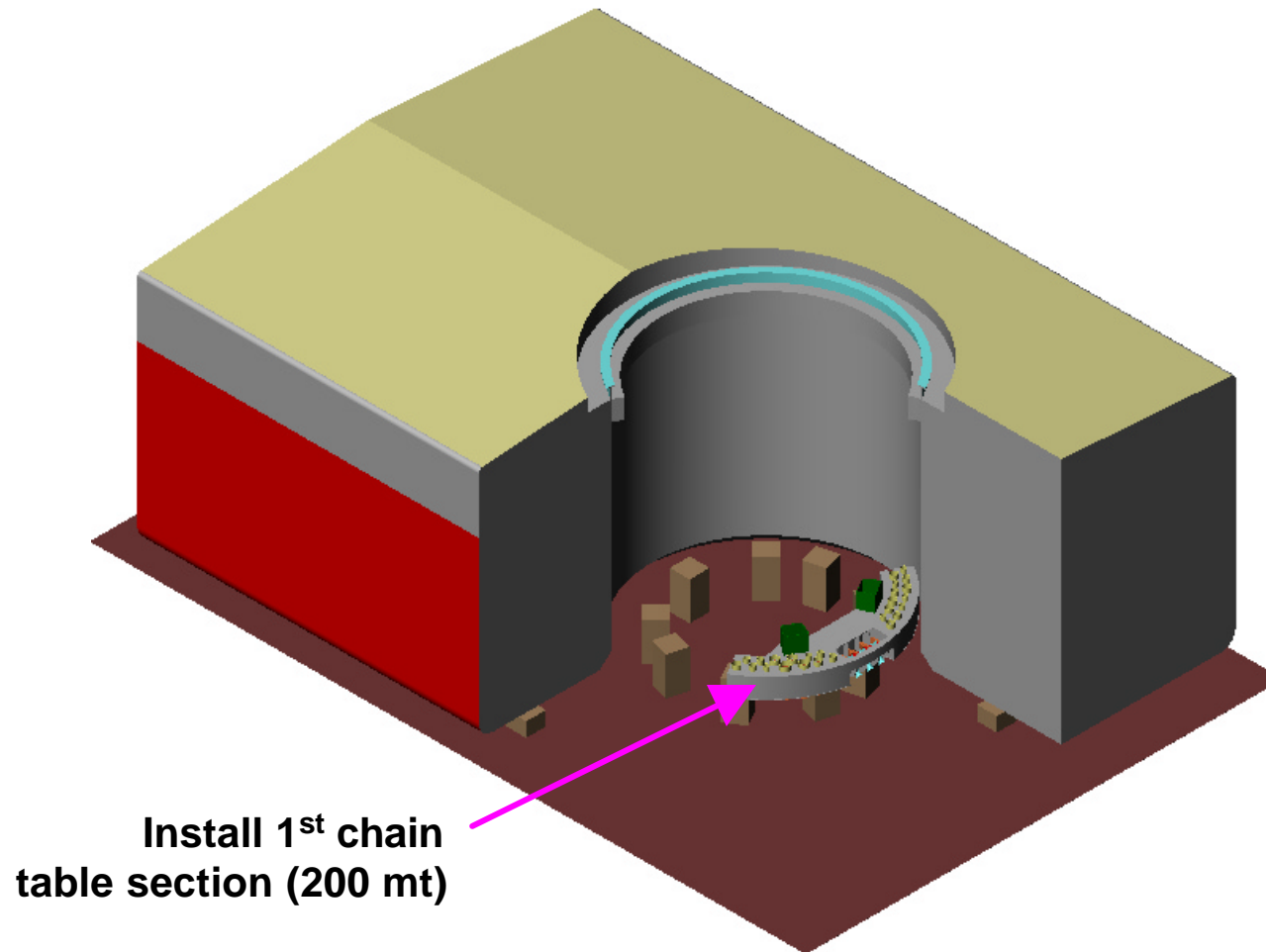
Machining of Bearing Surfaces for P-34 Barracuda Turret



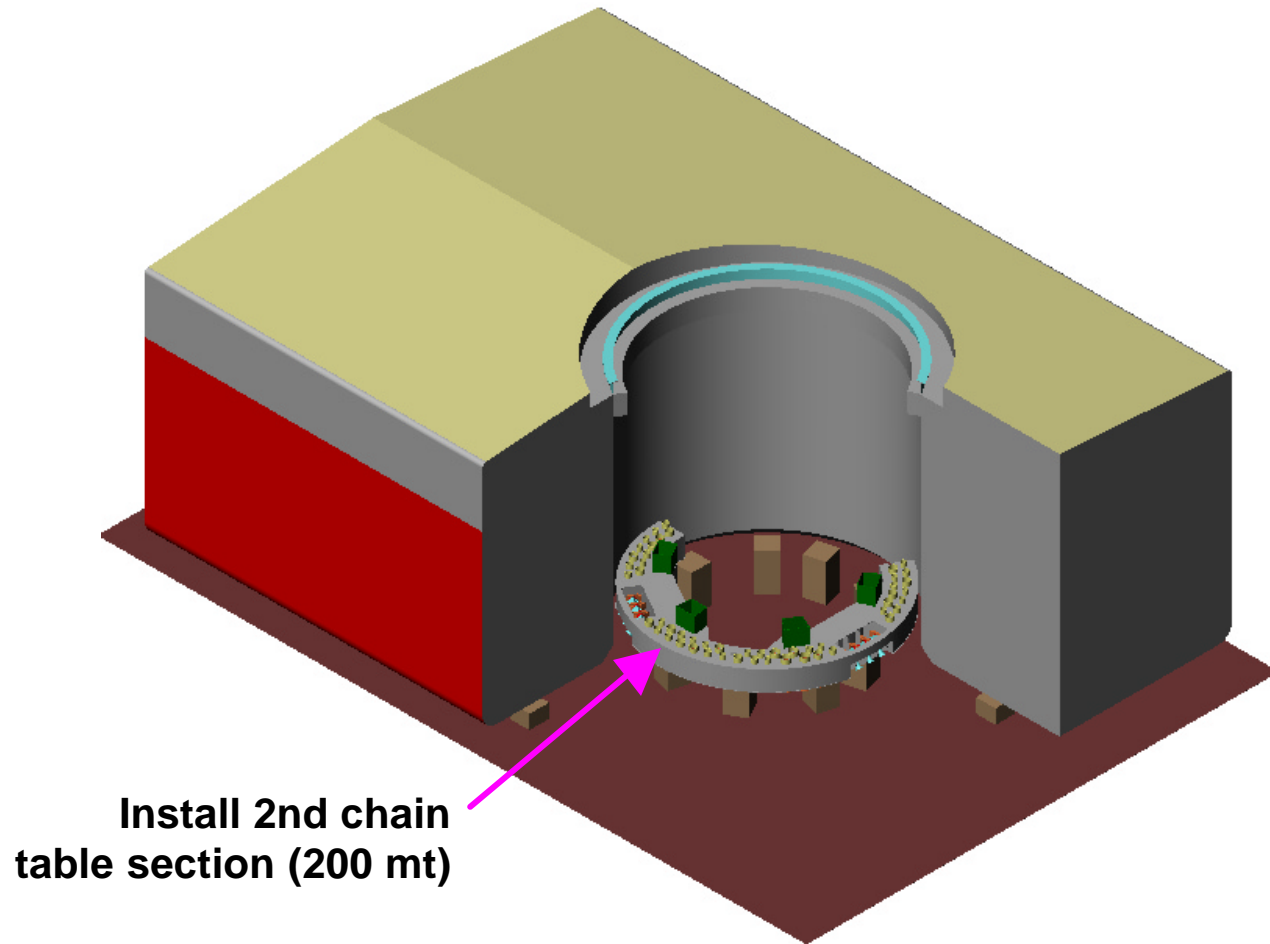
Limited Lift Construction - 3 Vessel in drydock



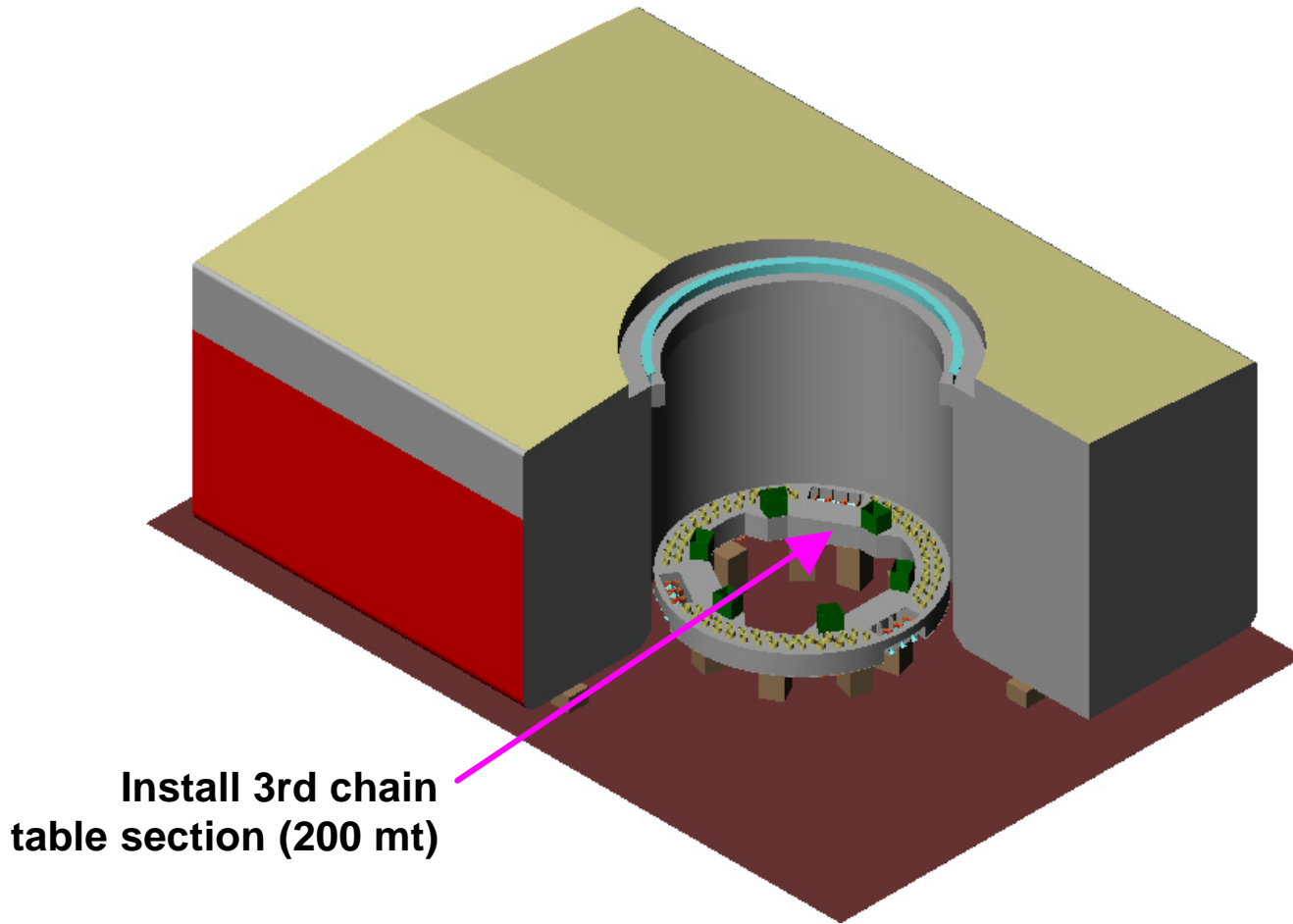
Limited Lift Construction - 4 Vessel in drydock



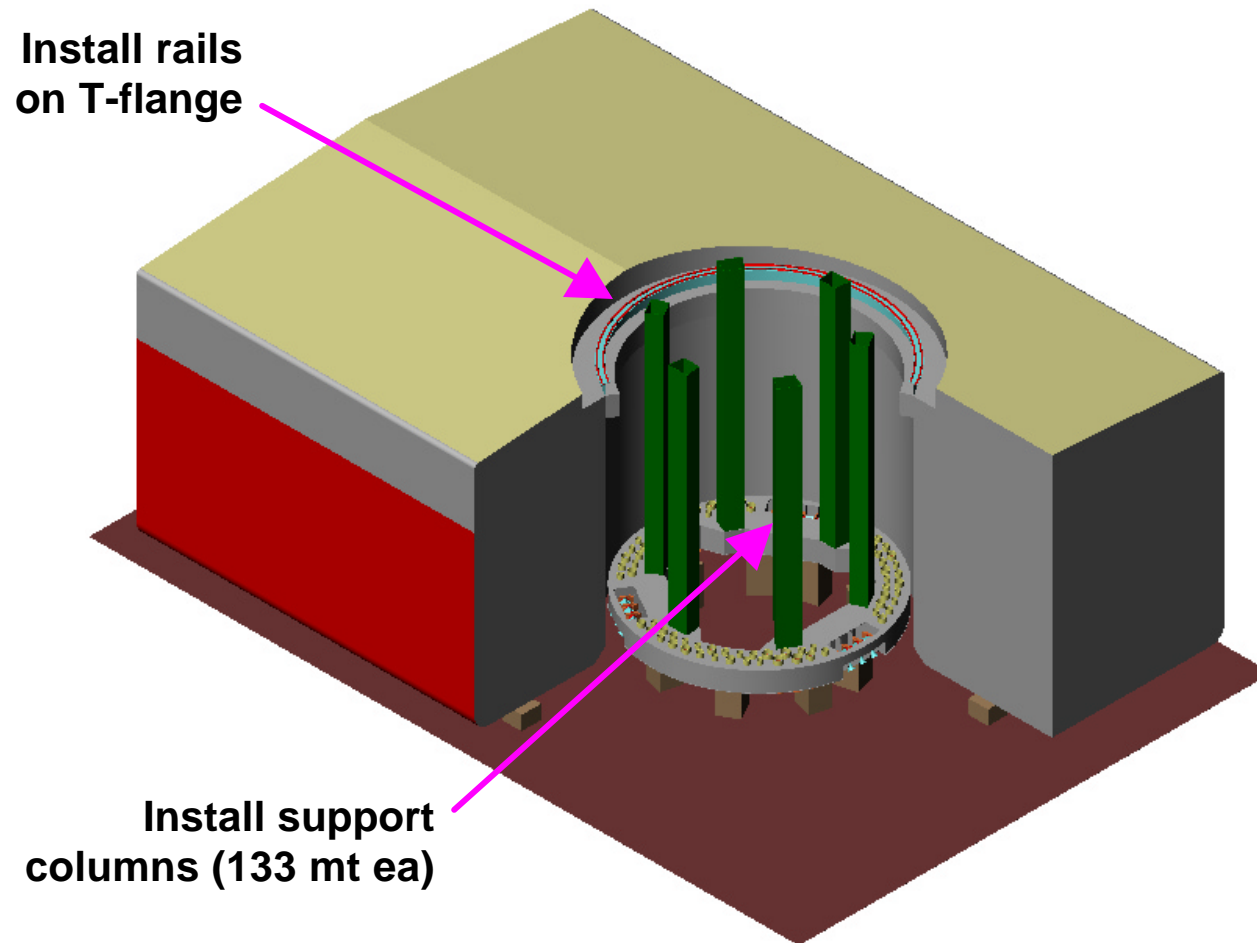
Limited Lift Construction - 5 Vessel in drydock



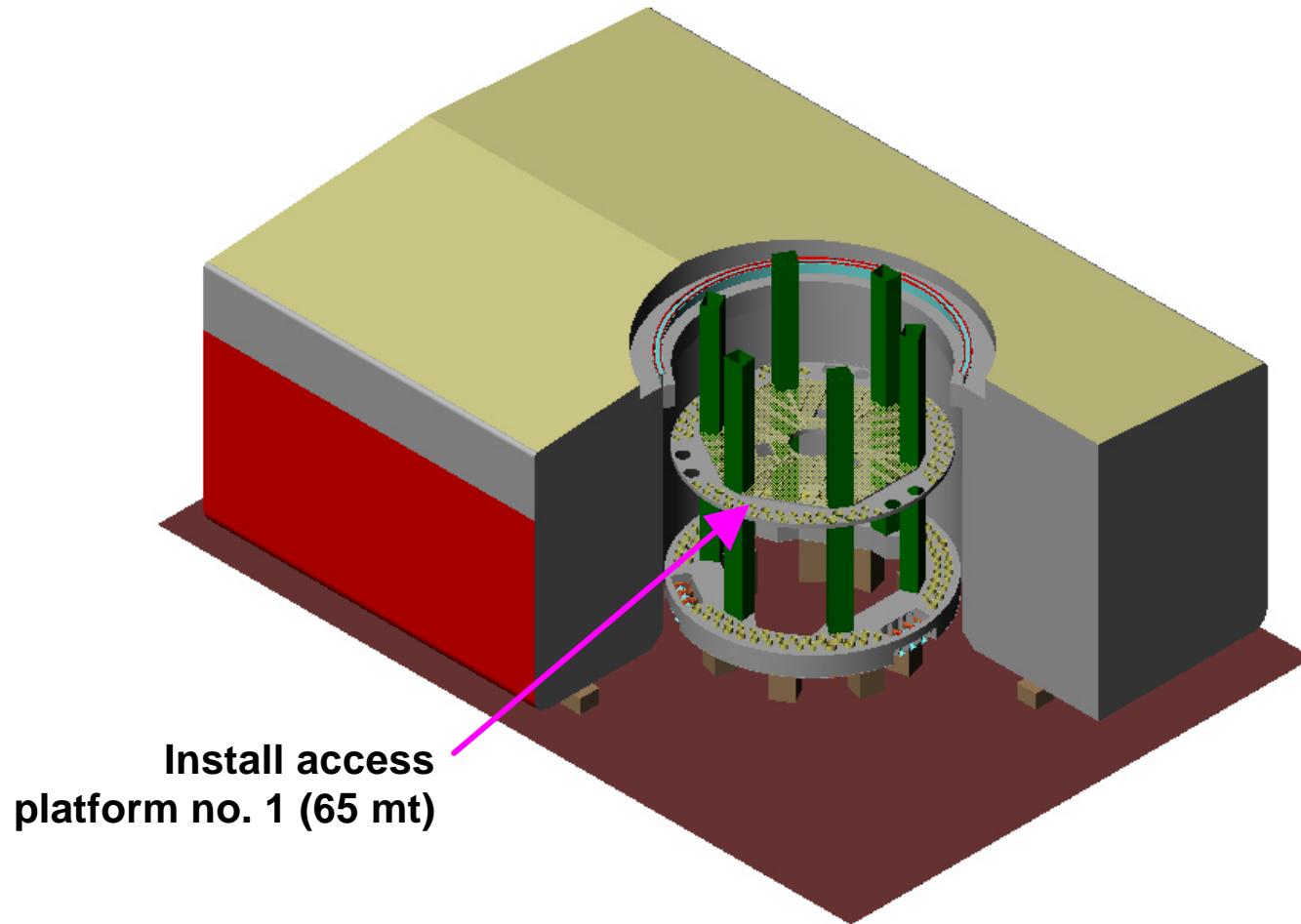
Limited Lift Construction - 6 Vessel in drydock



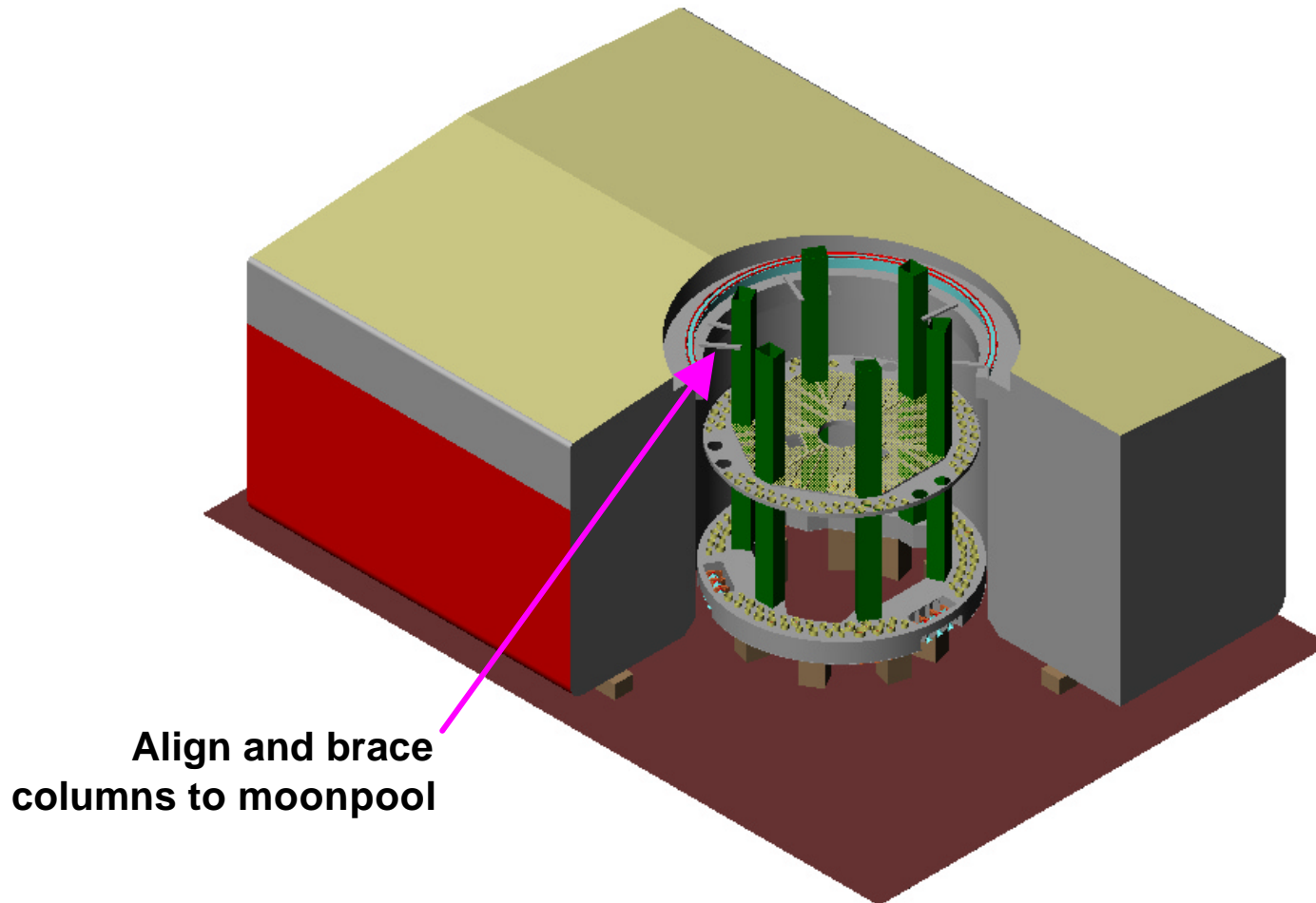
Limited Lift Construction - 7 Vessel in drydock



Limited Lift Construction - 8 Vessel in drydock



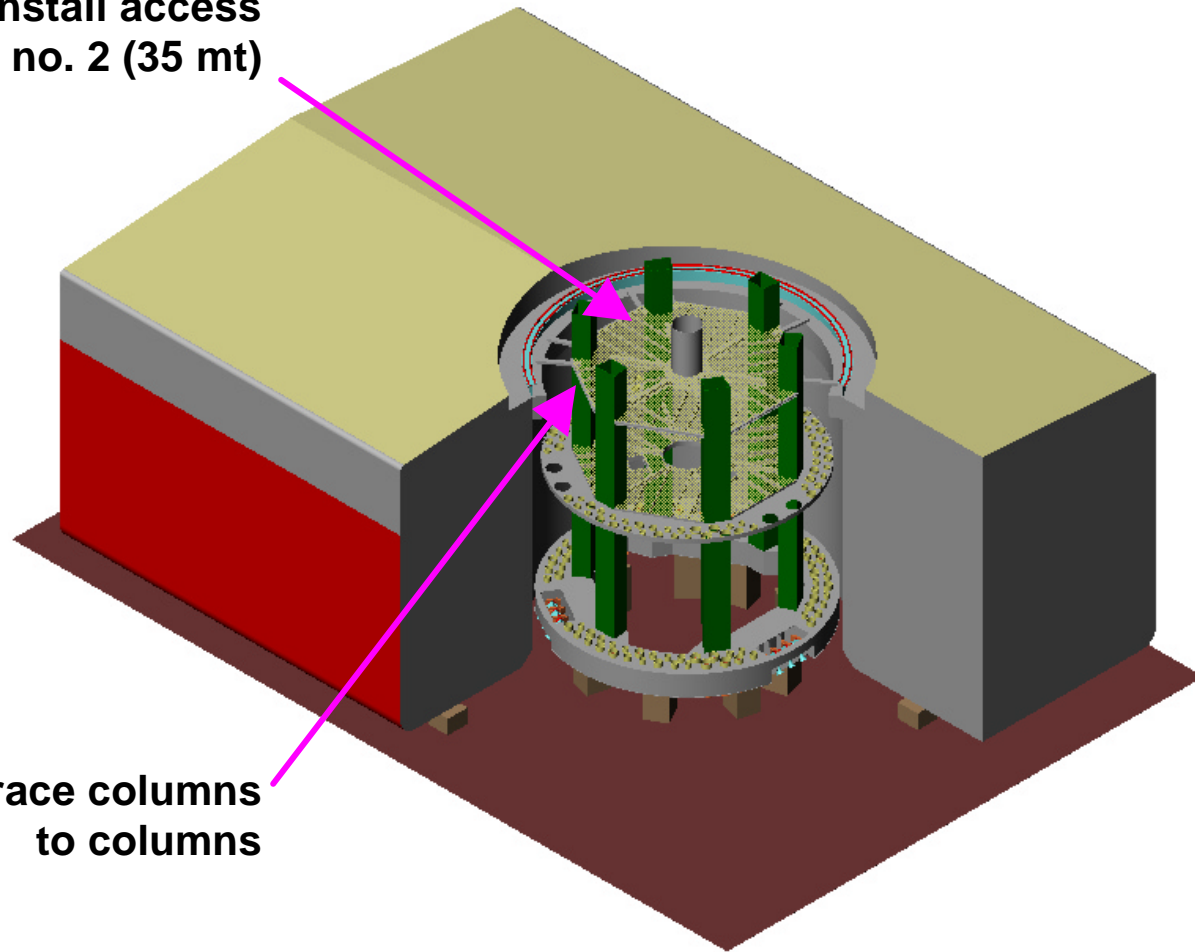
Limited Lift Construction - 9 Vessel in drydock



Limited Lift Construction - 10 Vessel in drydock

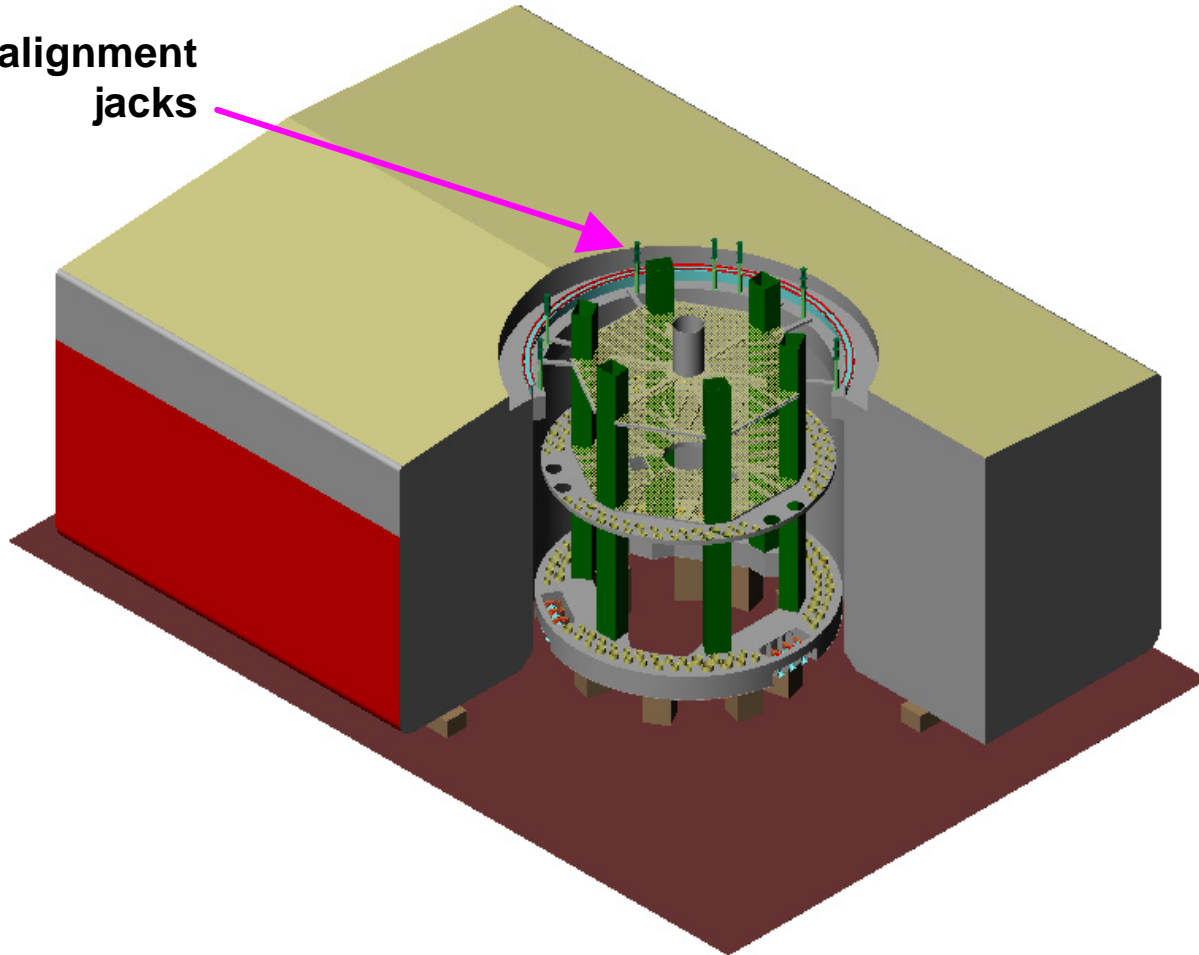
**Install access
platform no. 2 (35 mt)**

**Brace columns
to columns**

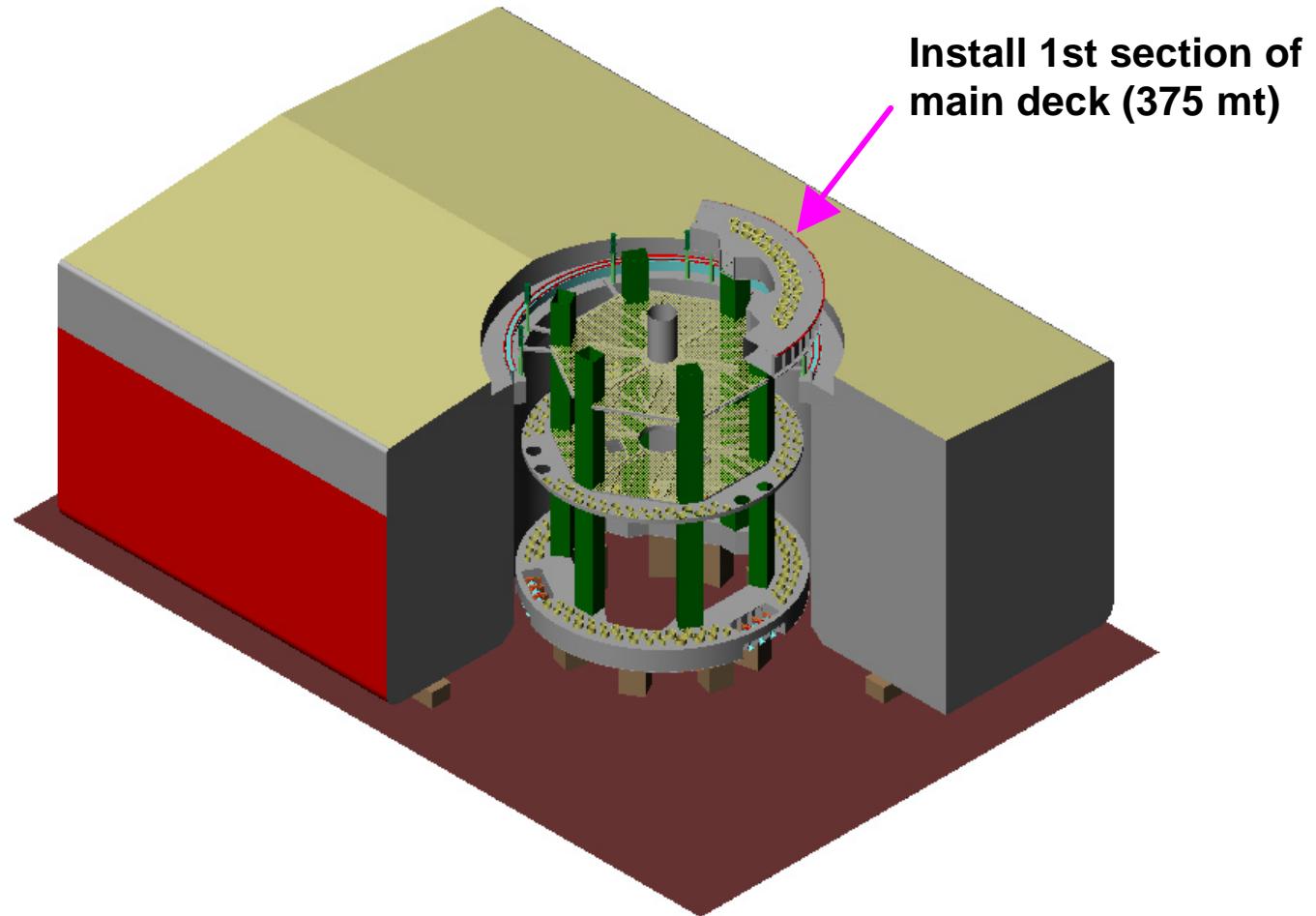


Limited Lift Construction - 11 Vessel in drydock

Install alignment
jacks

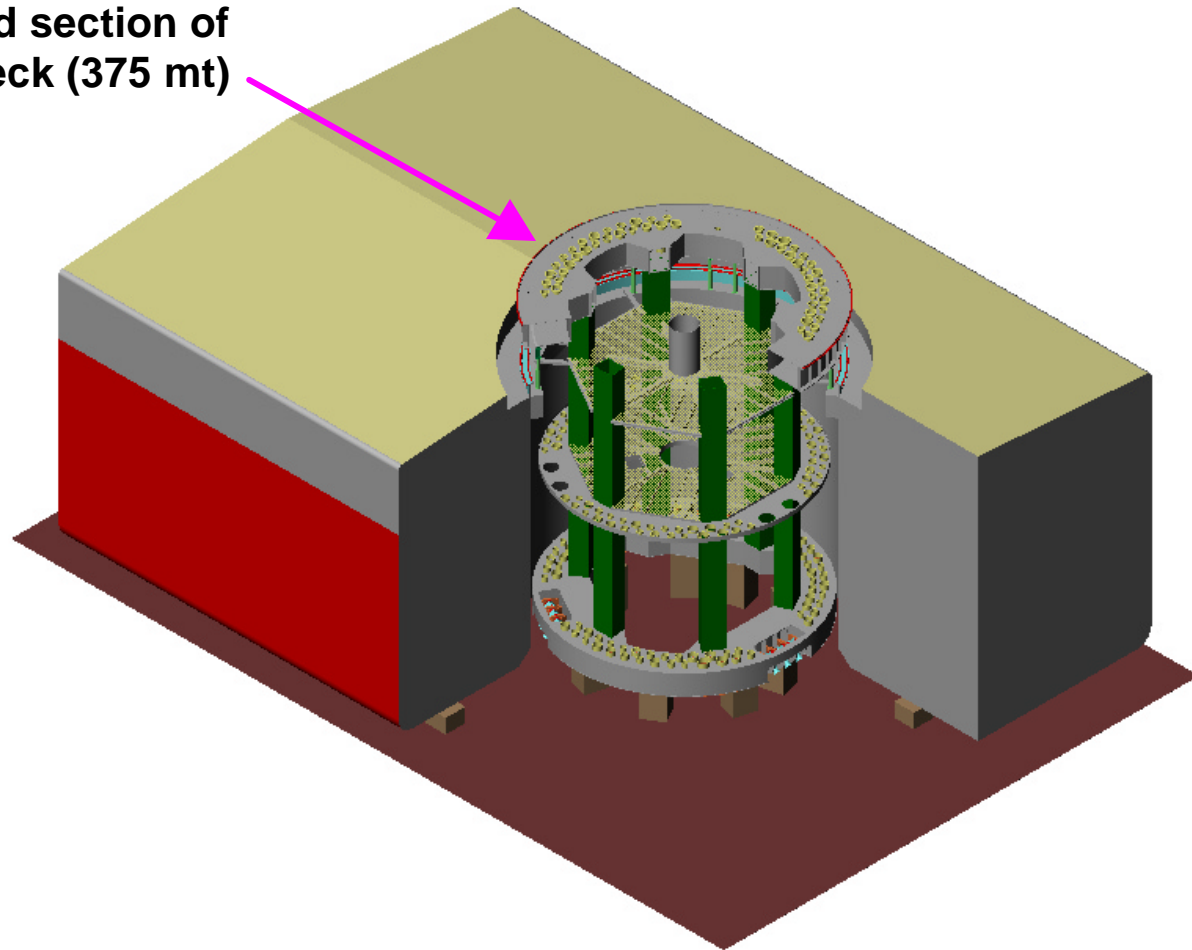


Limited Lift Construction - 12 Vessel in drydock

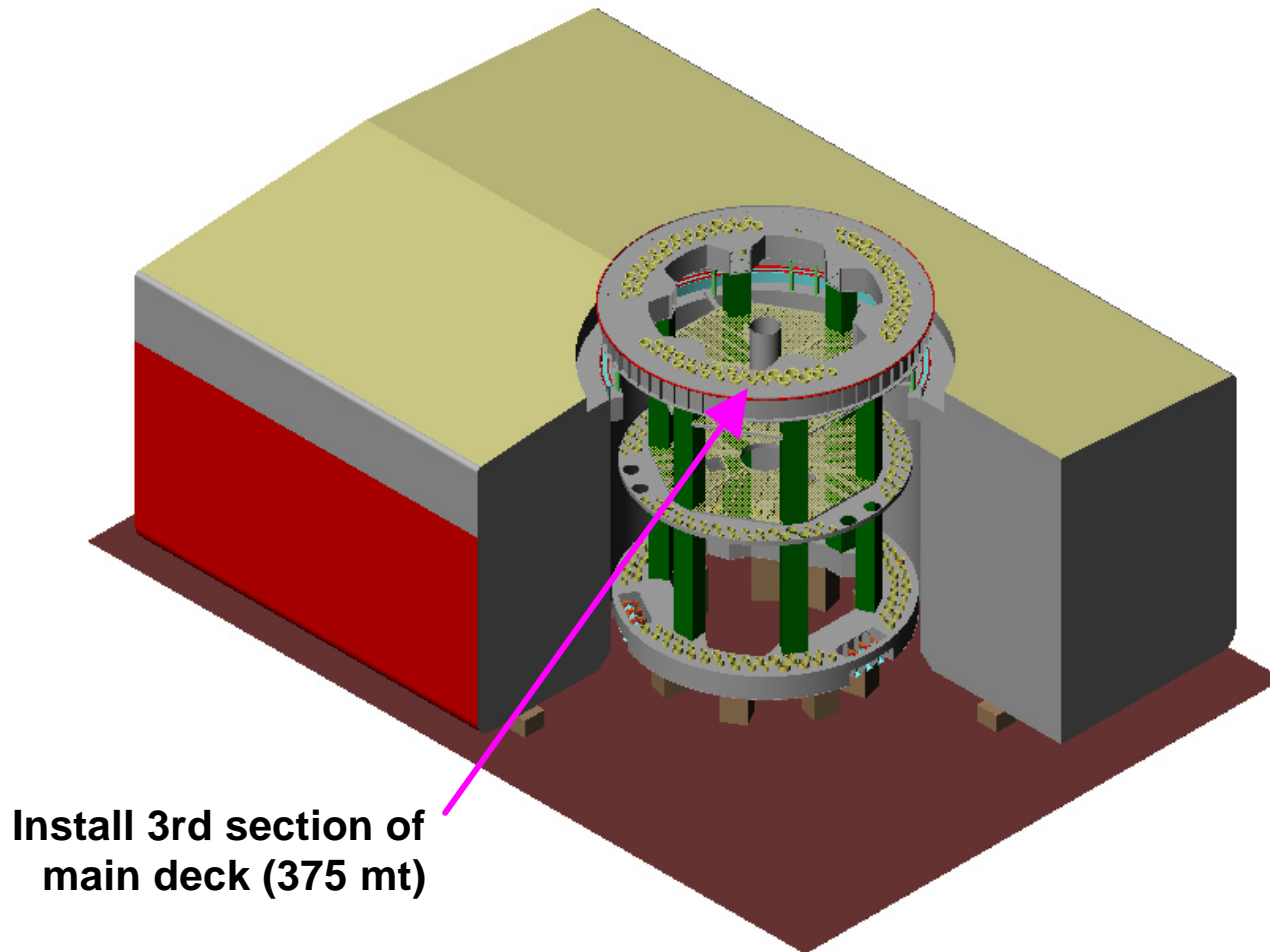


Limited Lift Construction - 13 Vessel in drydock

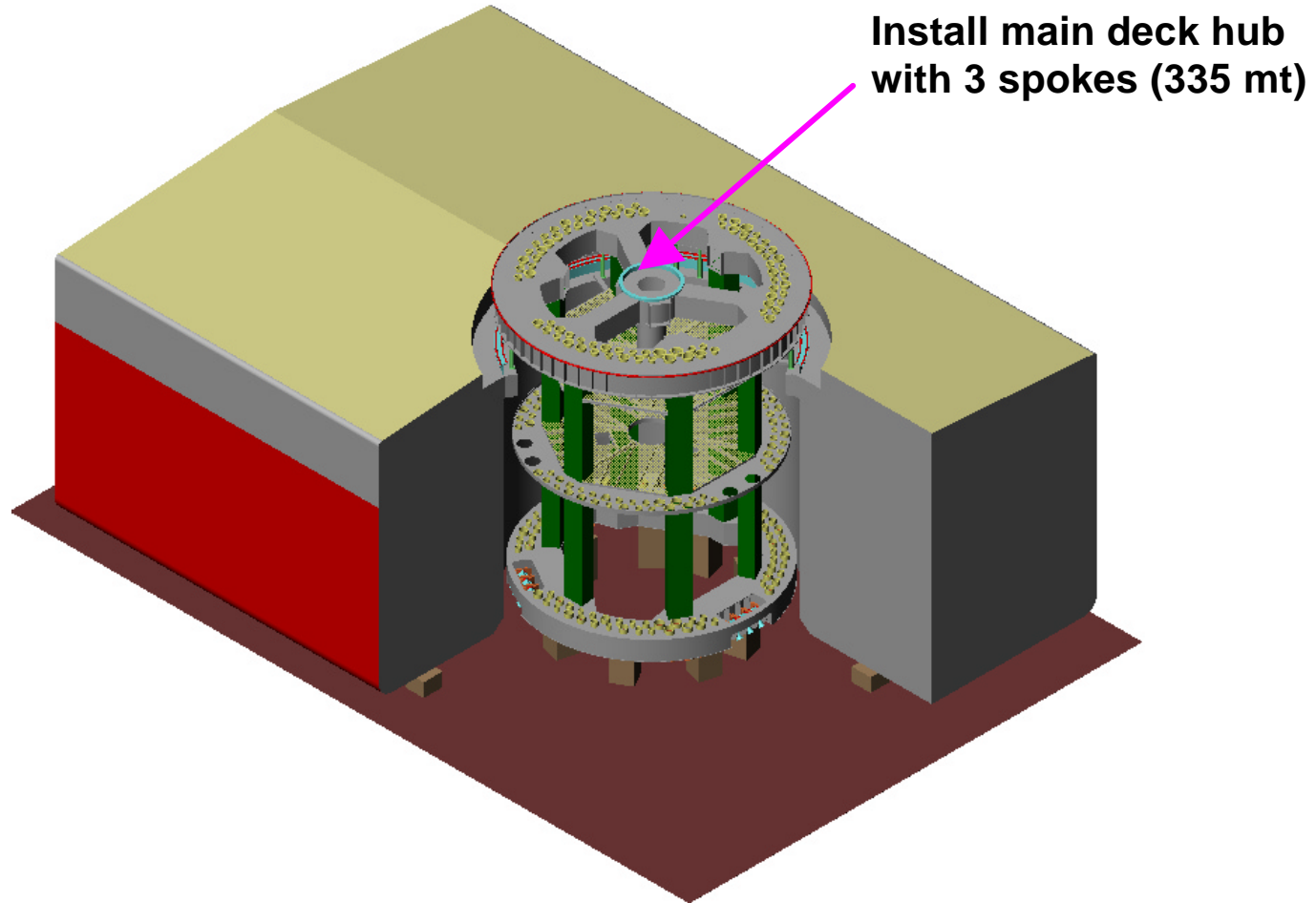
Install 2nd section of
main deck (375 mt)



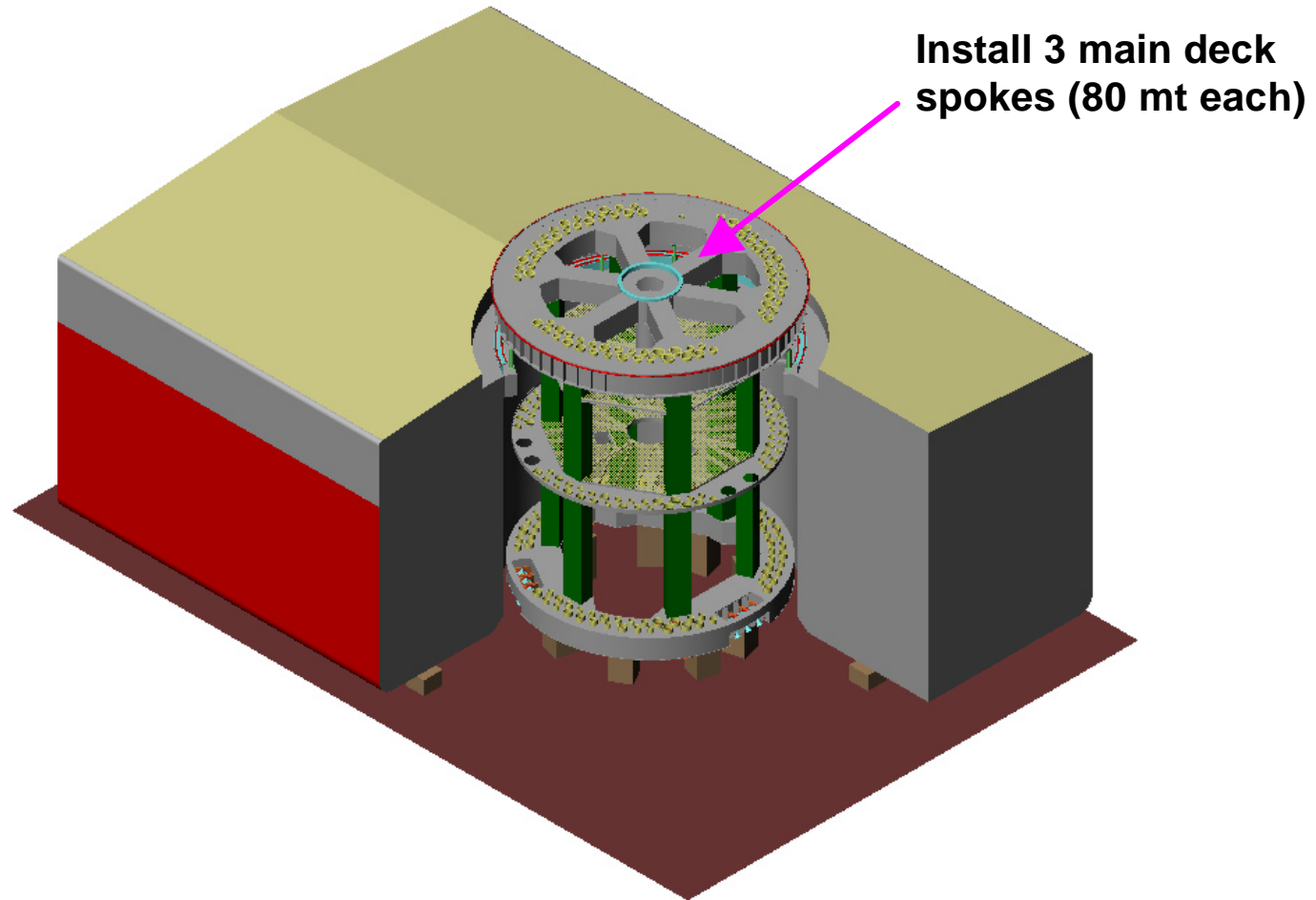
Limited Lift Construction - 14 Vessel in drydock



Limited Lift Construction - 15 Vessel in drydock



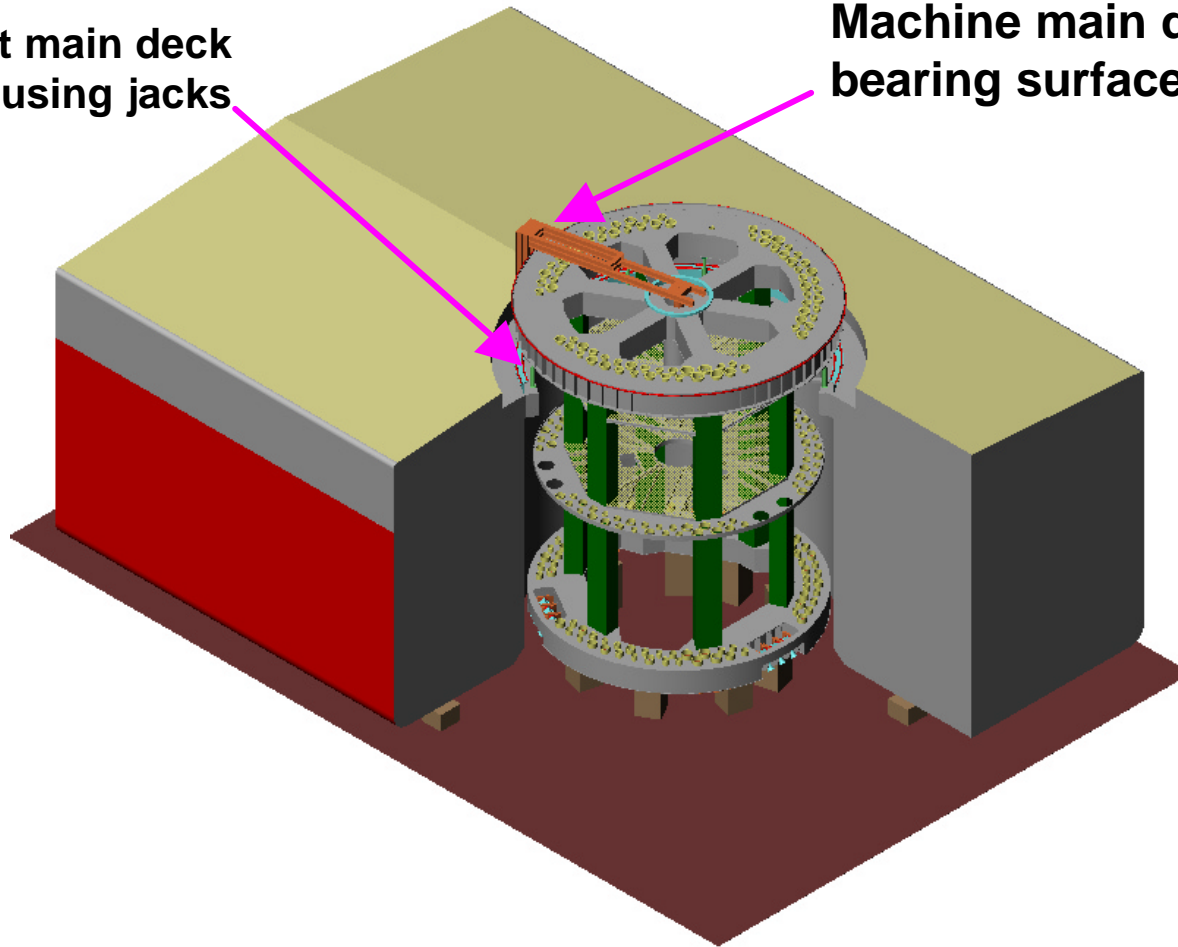
Limited Lift Construction - 16 Vessel in drydock



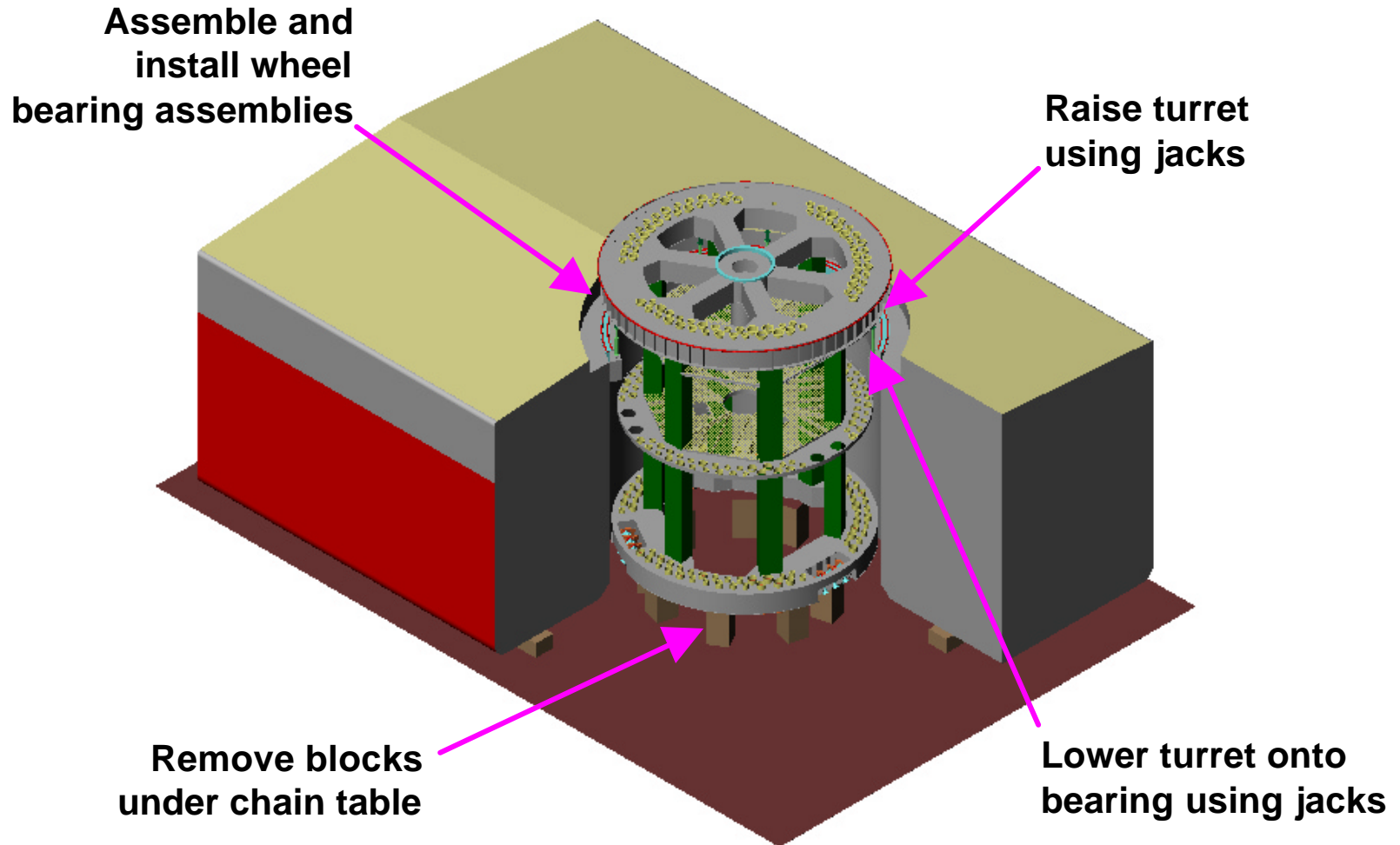
Limited Lift Construction - 17 Vessel in drydock

Fine adjust main deck
flatness using jacks

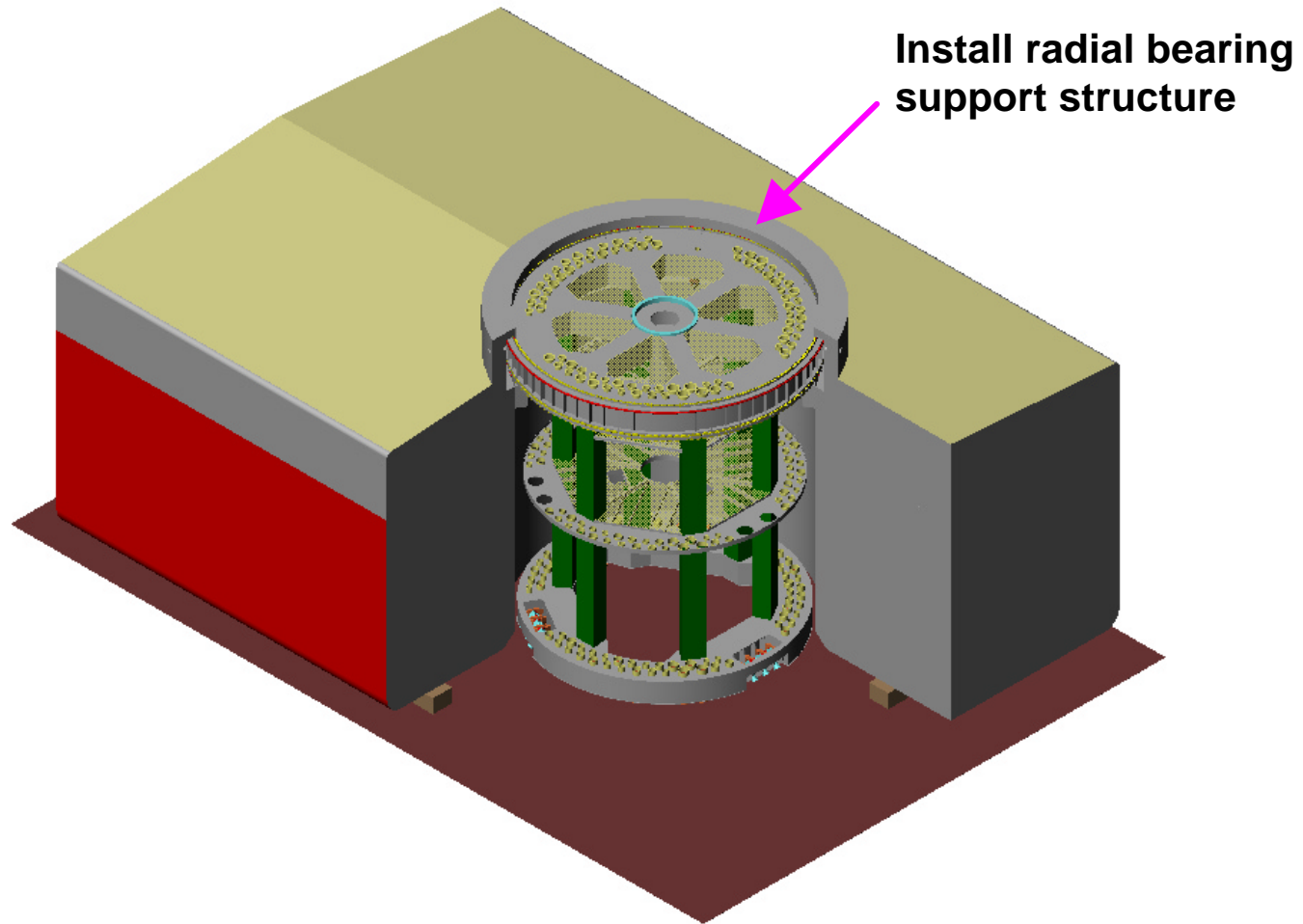
Machine main deck
bearing surfaces (3)



Limited Lift Construction - 18 Vessel in drydock



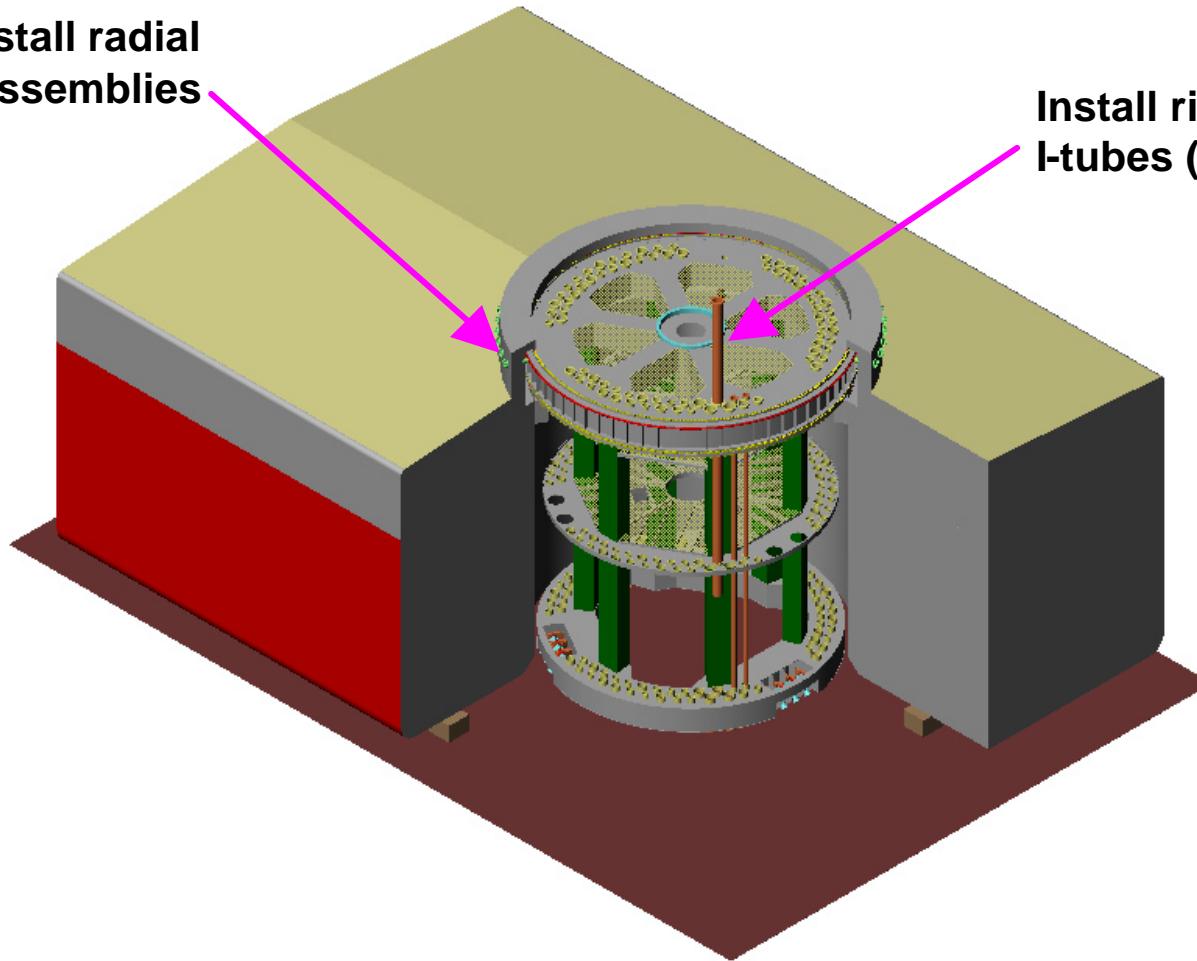
Limited Lift Construction - 19 Vessel in drydock



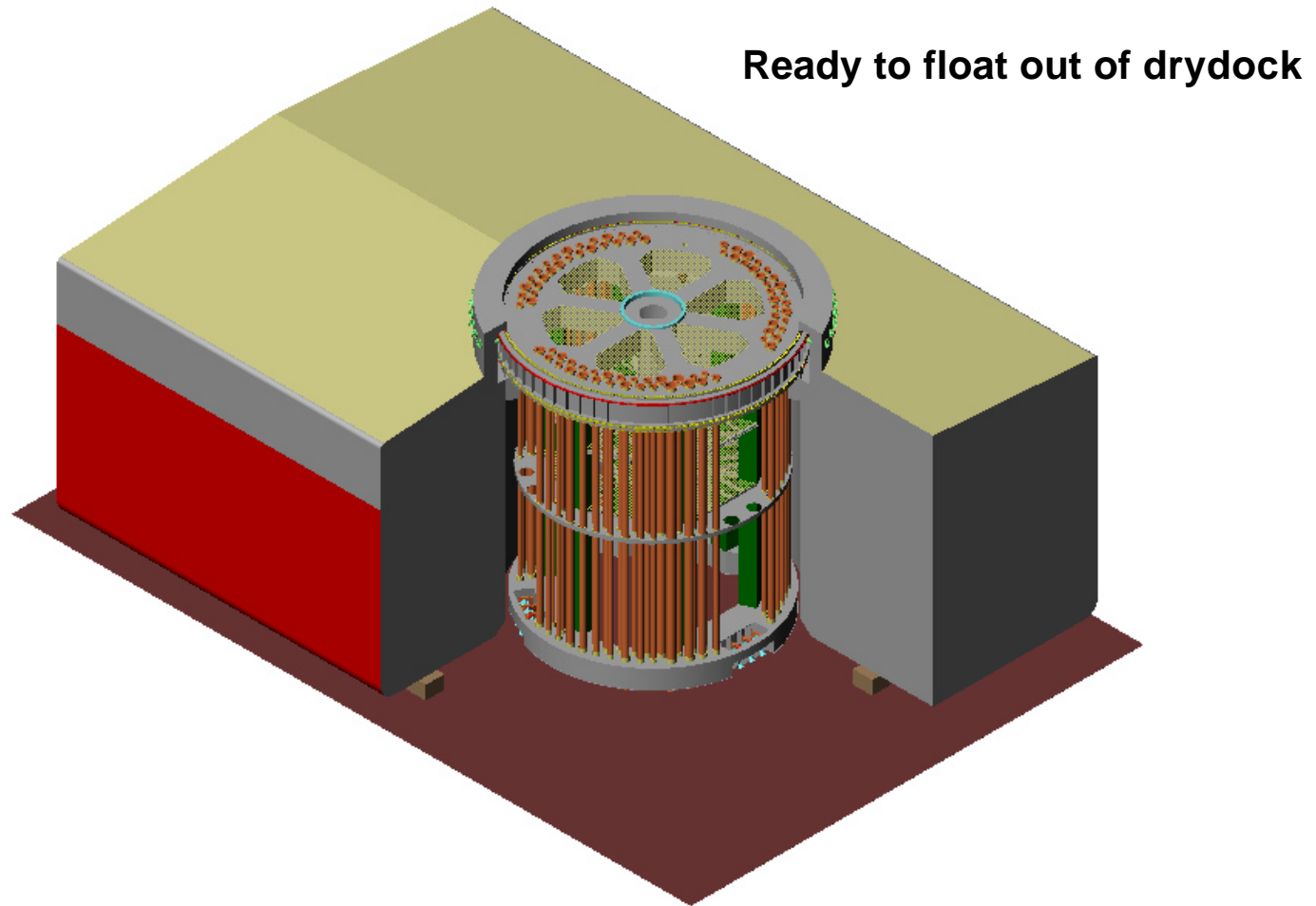
Limited Lift Construction - 20 Vessel in drydock

Install radial bearing assemblies

Install riser I-tubes (7 mt ea)



Limited Lift Construction - 21 Vessel in drydock



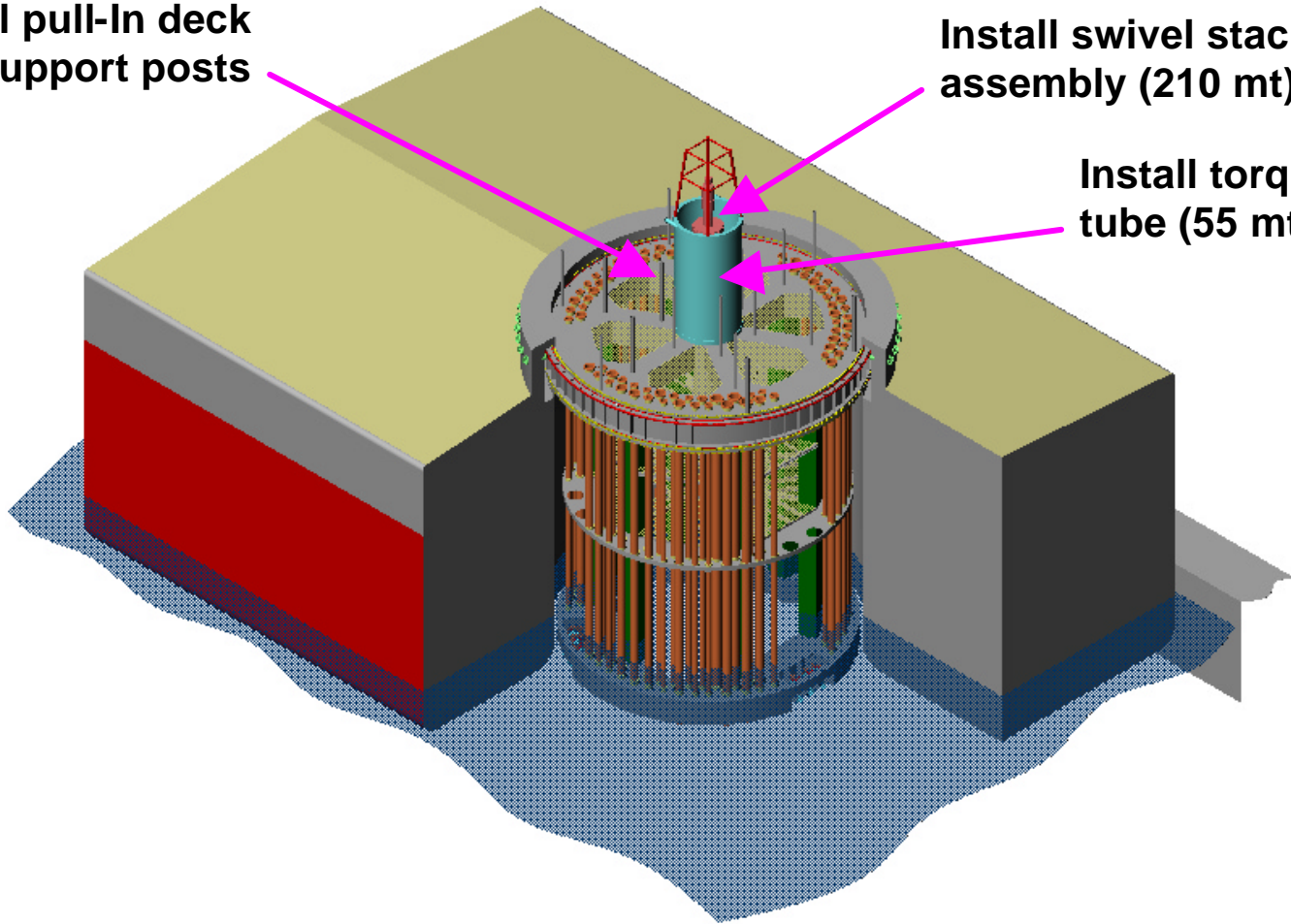
Limited Lift Construction - 22

Vessel floating dockside

Install pull-In deck
support posts

Install swivel stack
assembly (210 mt)

Install torque
tube (55 mt)

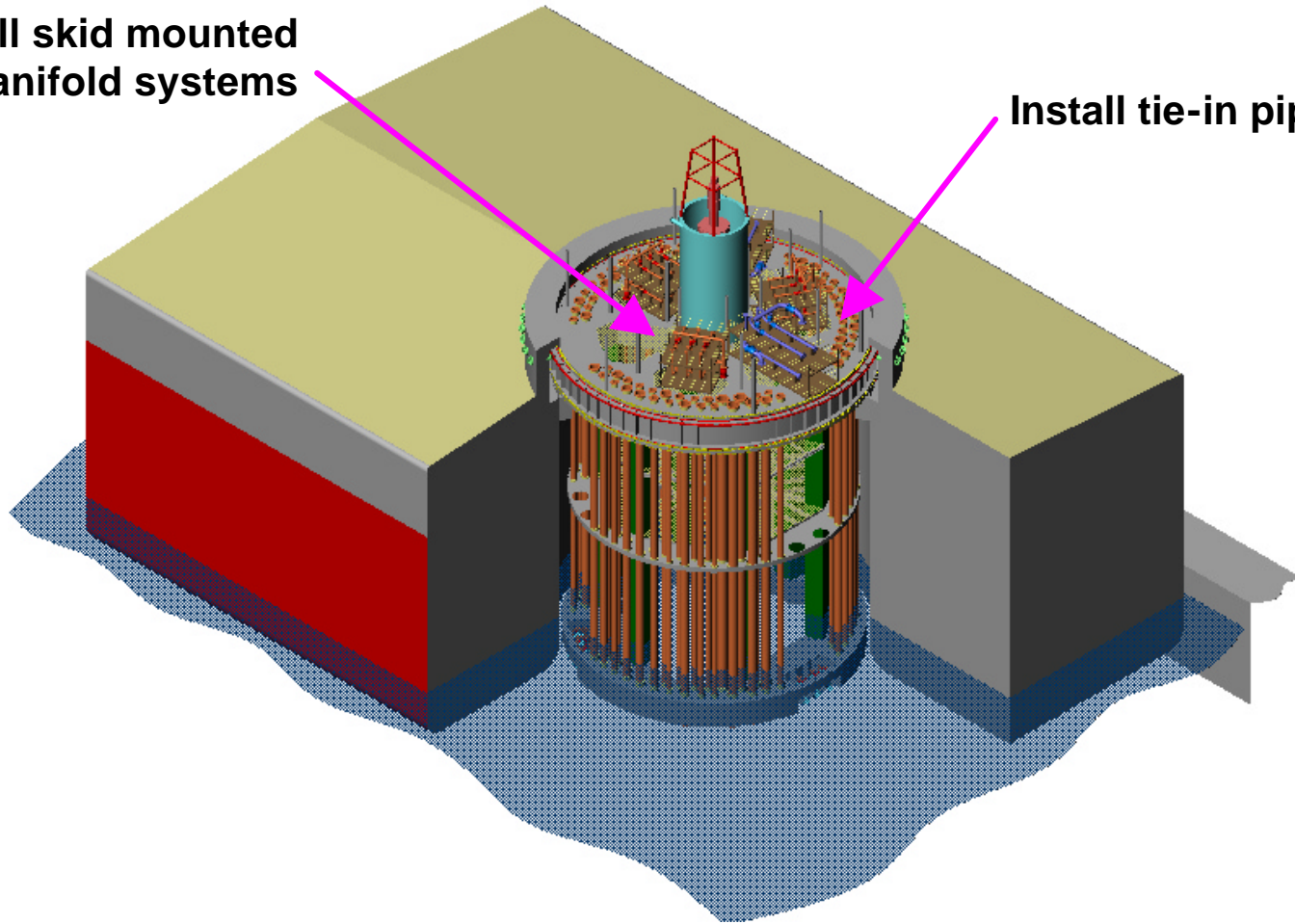


Limited Lift Construction - 23

Vessel floating dockside

Install skid mounted manifold systems

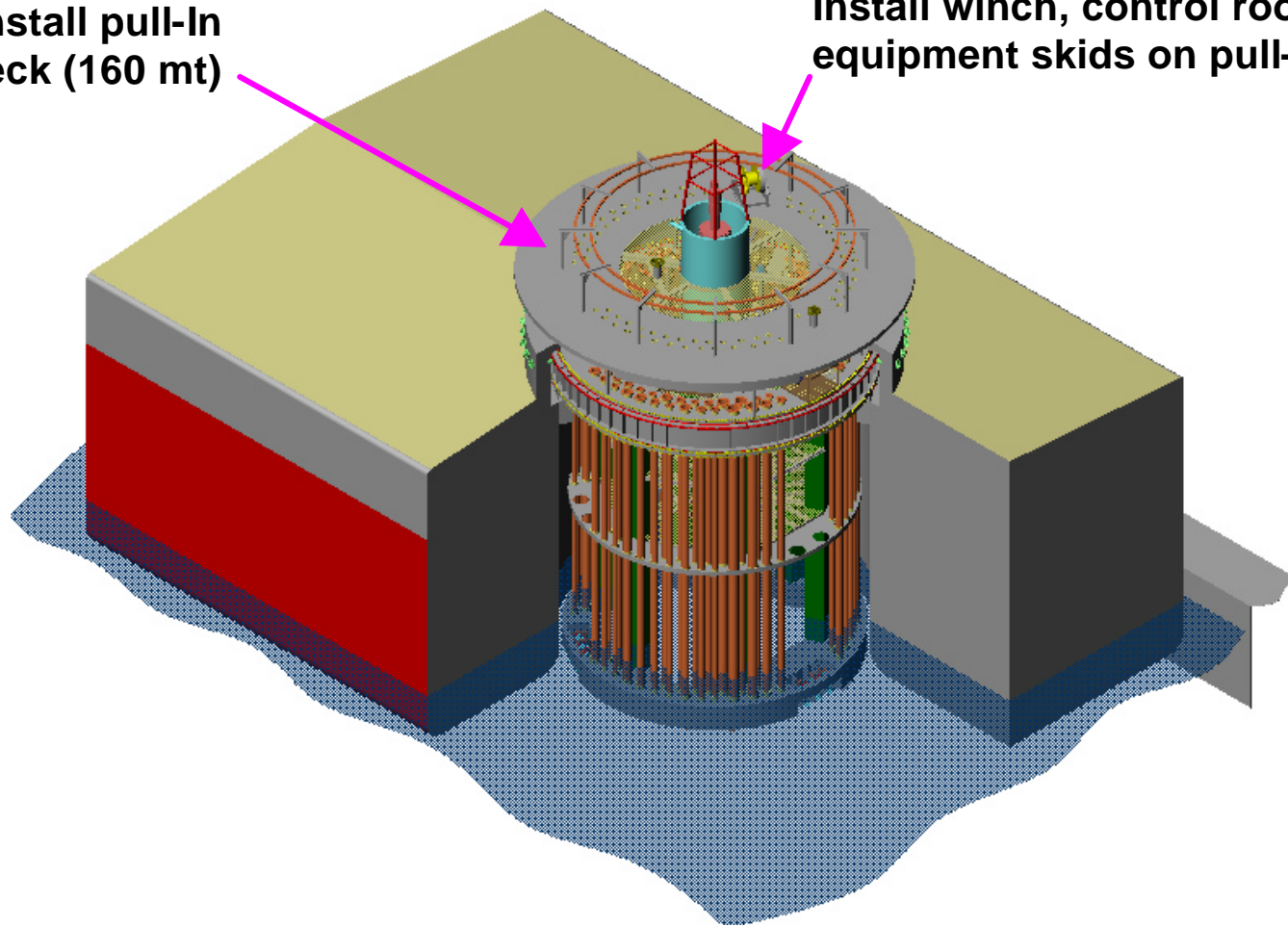
Install tie-in piping



Limited Lift Construction - 24 Vessel floating dockside

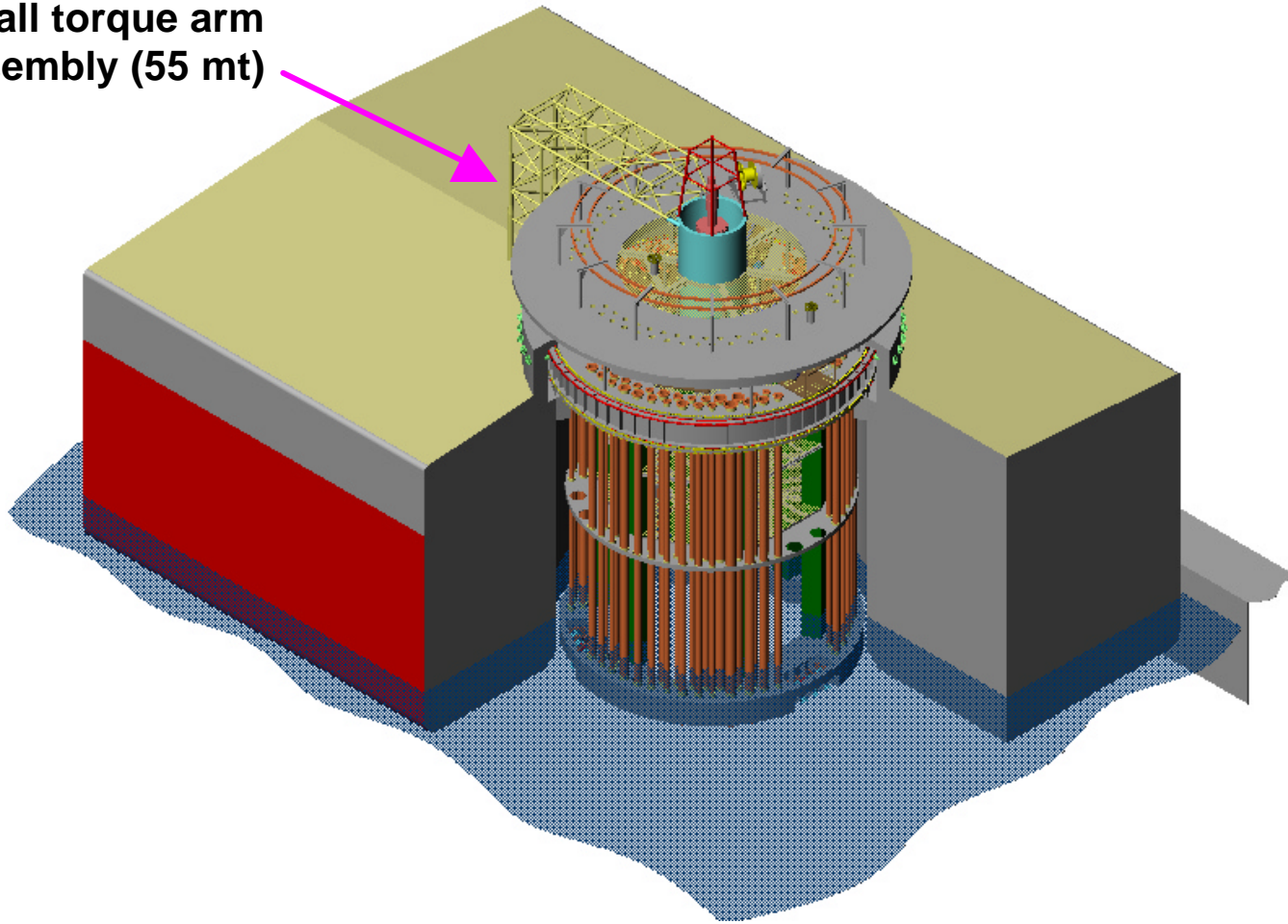
Install pull-In
deck (160 mt)

Install winch, control room and
equipment skids on pull-in deck

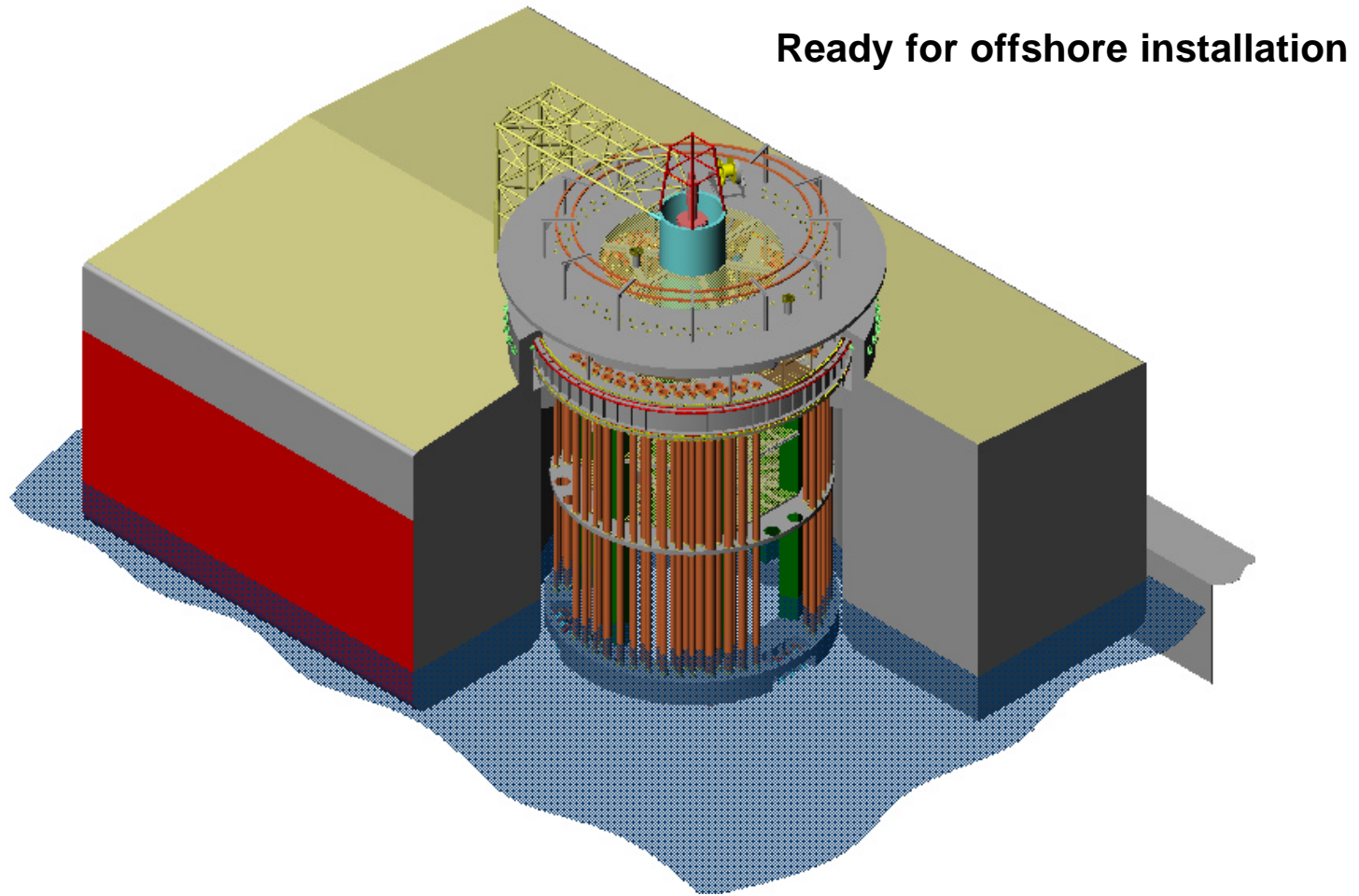


Limited Lift Construction - 25 Vessel floating dockside

Install torque arm
assembly (55 mt)



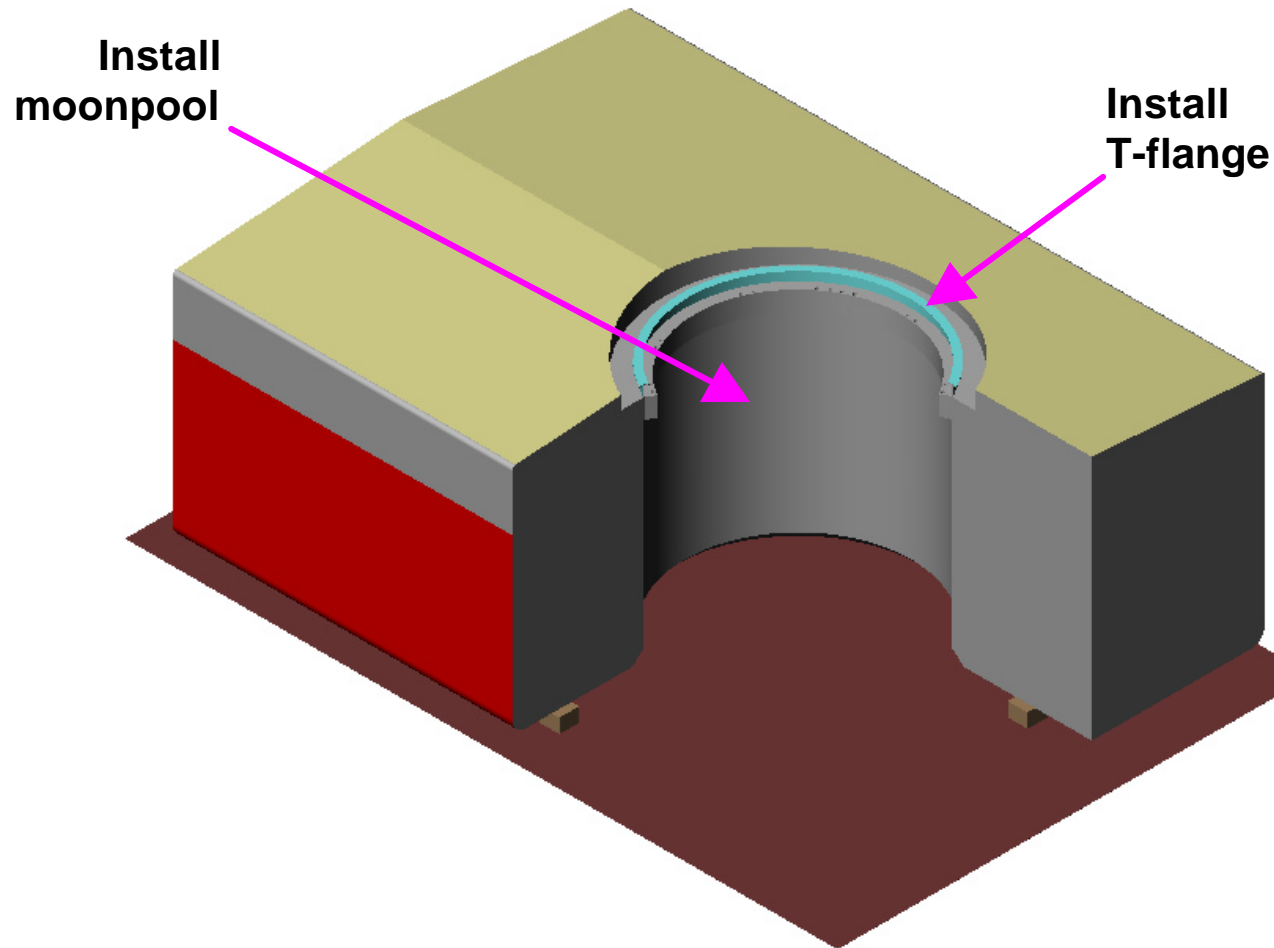
Limited Lift Construction - 26 Vessel floating dockside



VLT Construction Sequence using Heavy Lift Capacity Cranes

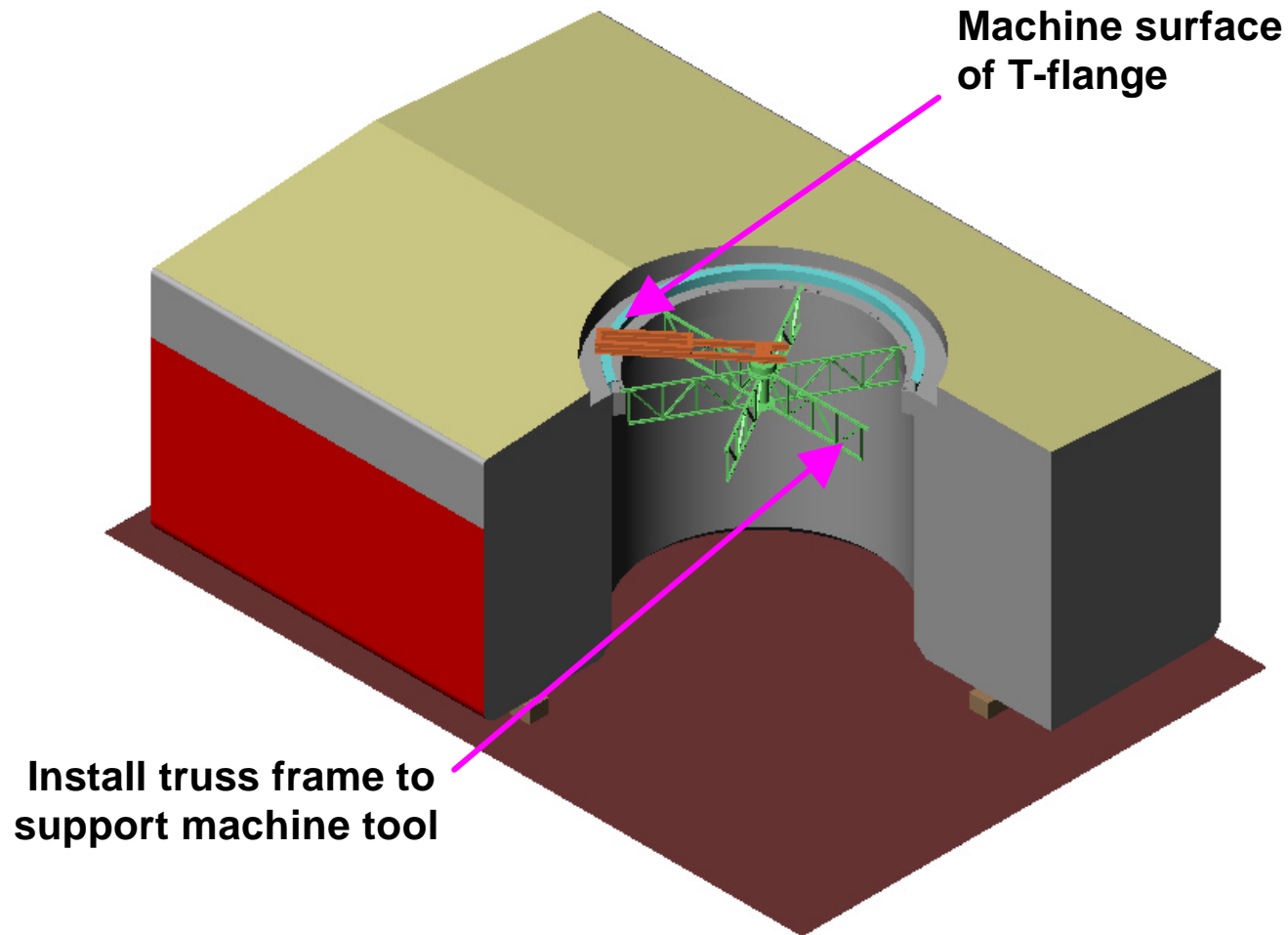
Heavy Lift Construction - 1

Vessel floating or in drydock

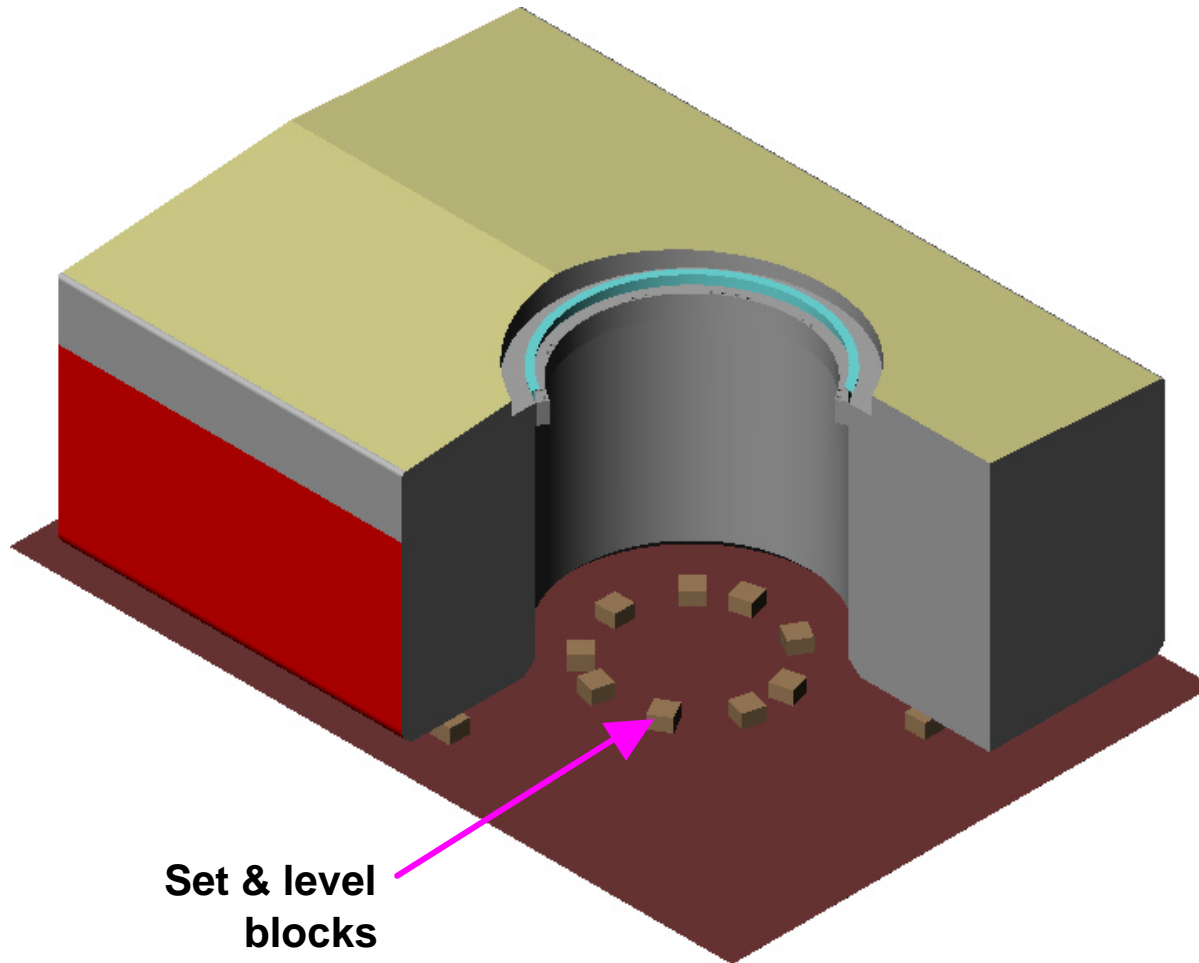


Heavy Lift Construction - 2

Vessel floating or in drydock

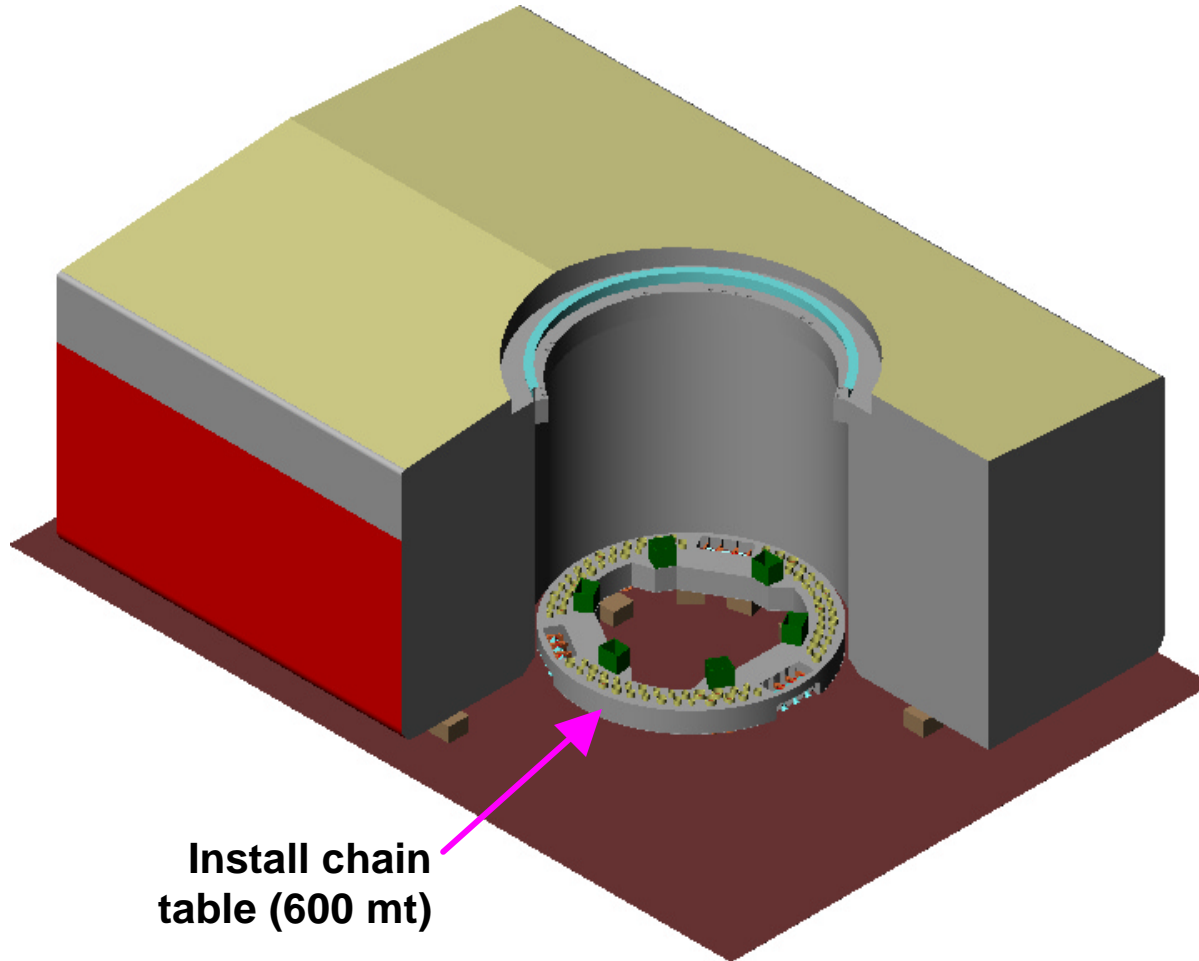


Heavy Lift Construction - 3 Vessel in drydock



Set & level
blocks

Heavy Lift Construction - 4 Vessel in drydock

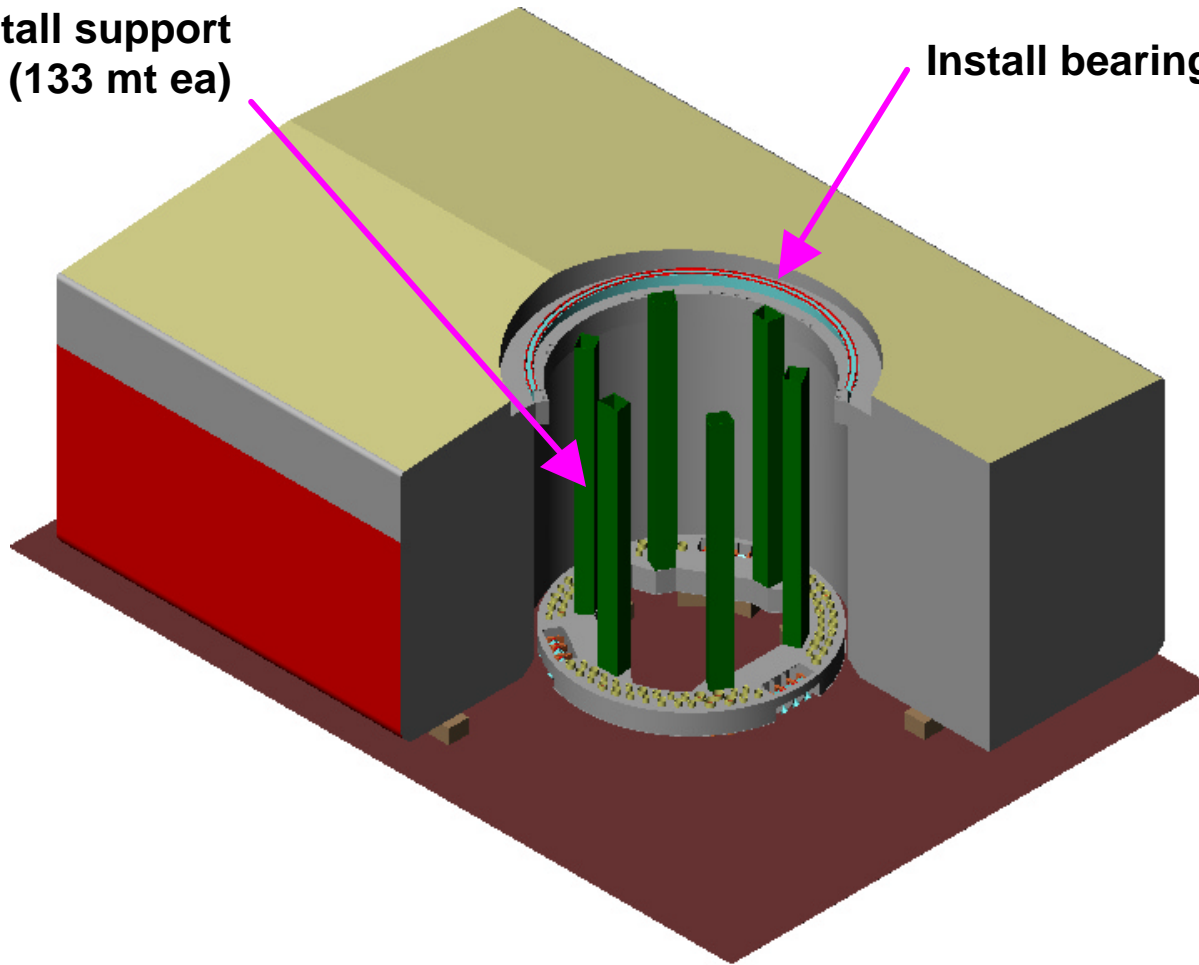


**Install chain
table (600 mt)**

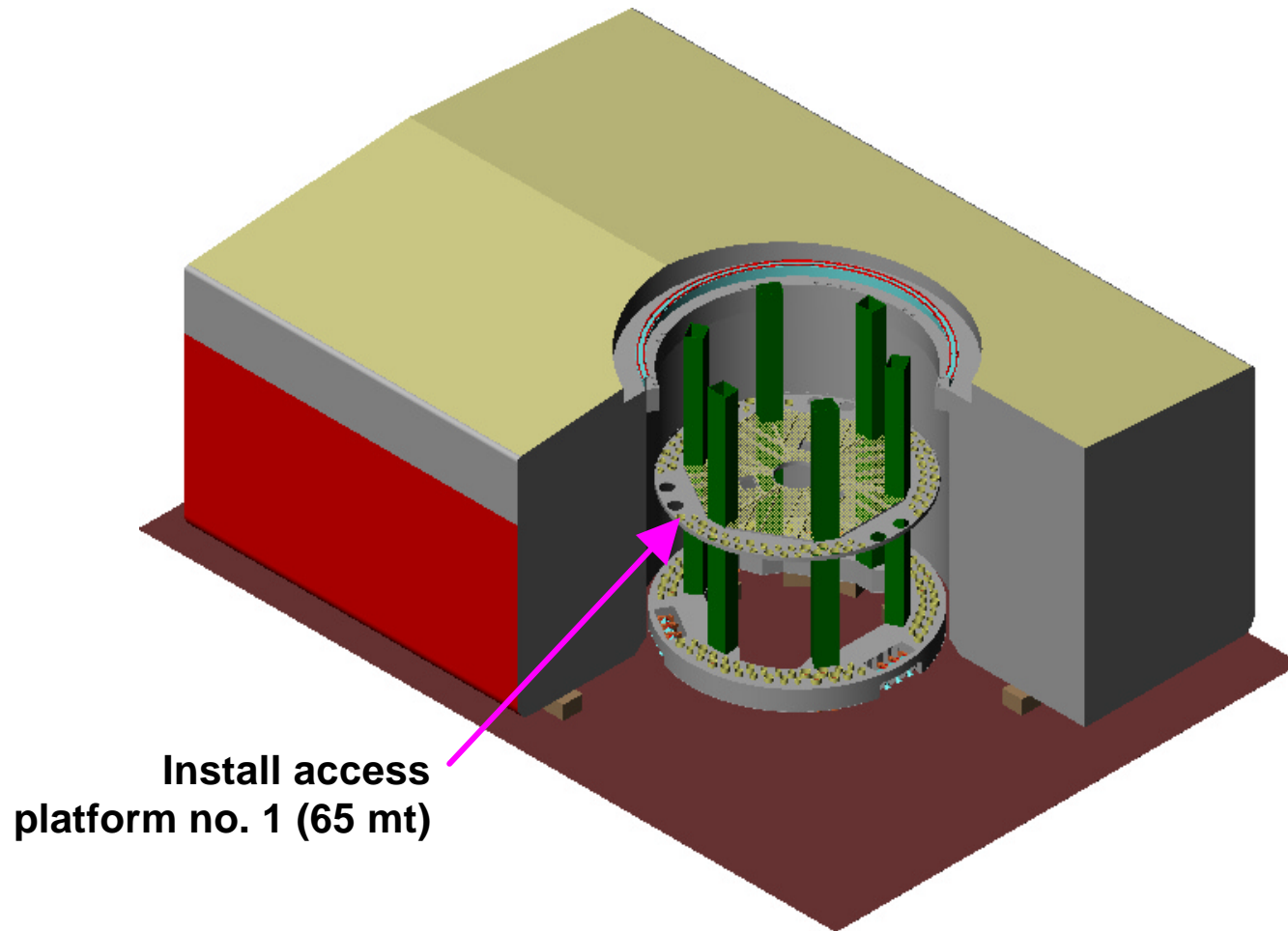
Heavy Lift Construction - 5 Vessel in drydock

Install support
columns (133 mt ea)

Install bearing rails



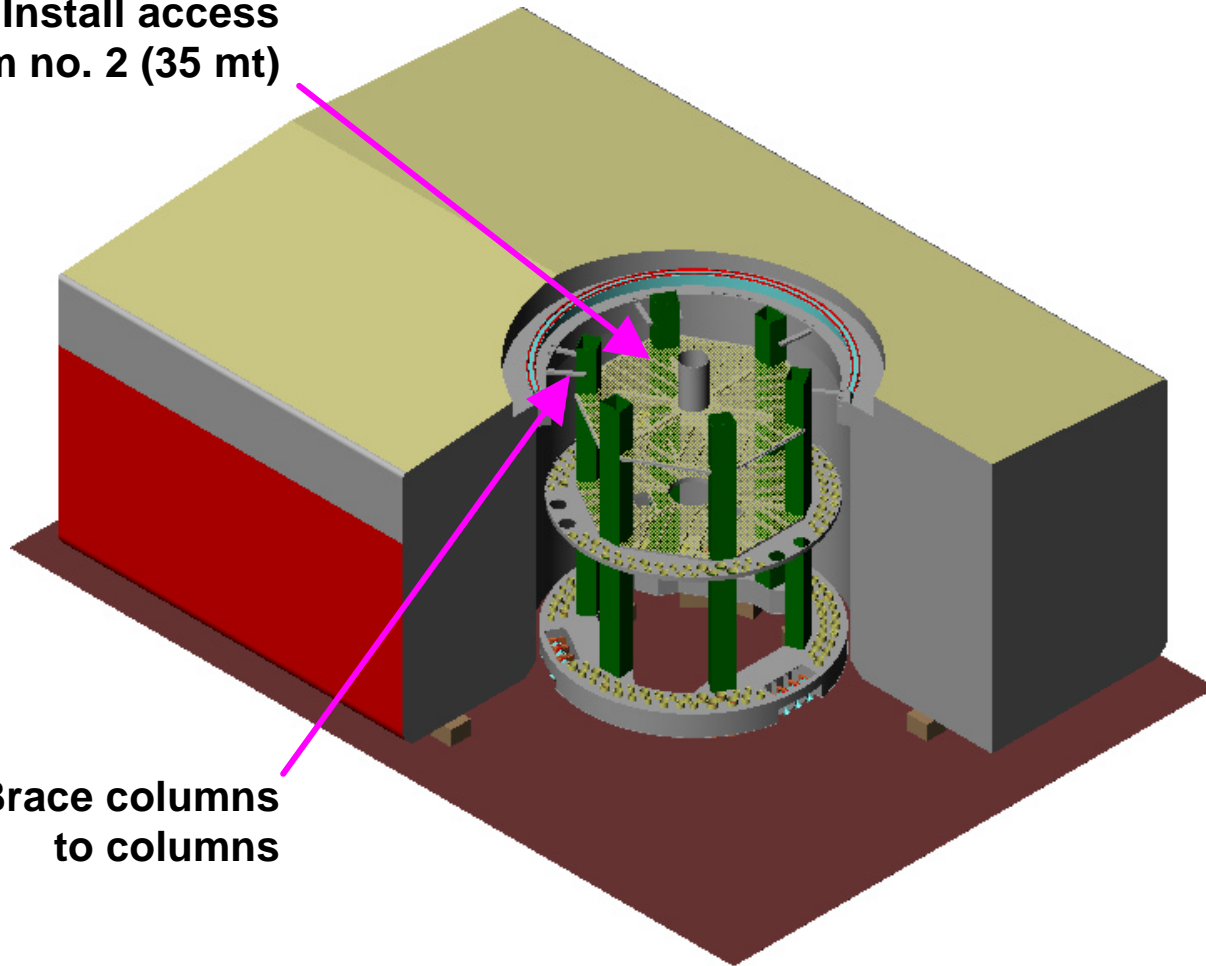
Heavy Lift Construction - 6 Vessel in drydock



Heavy Lift Construction - 7 Vessel in drydock

**Install access
platform no. 2 (35 mt)**

**Brace columns
to columns**

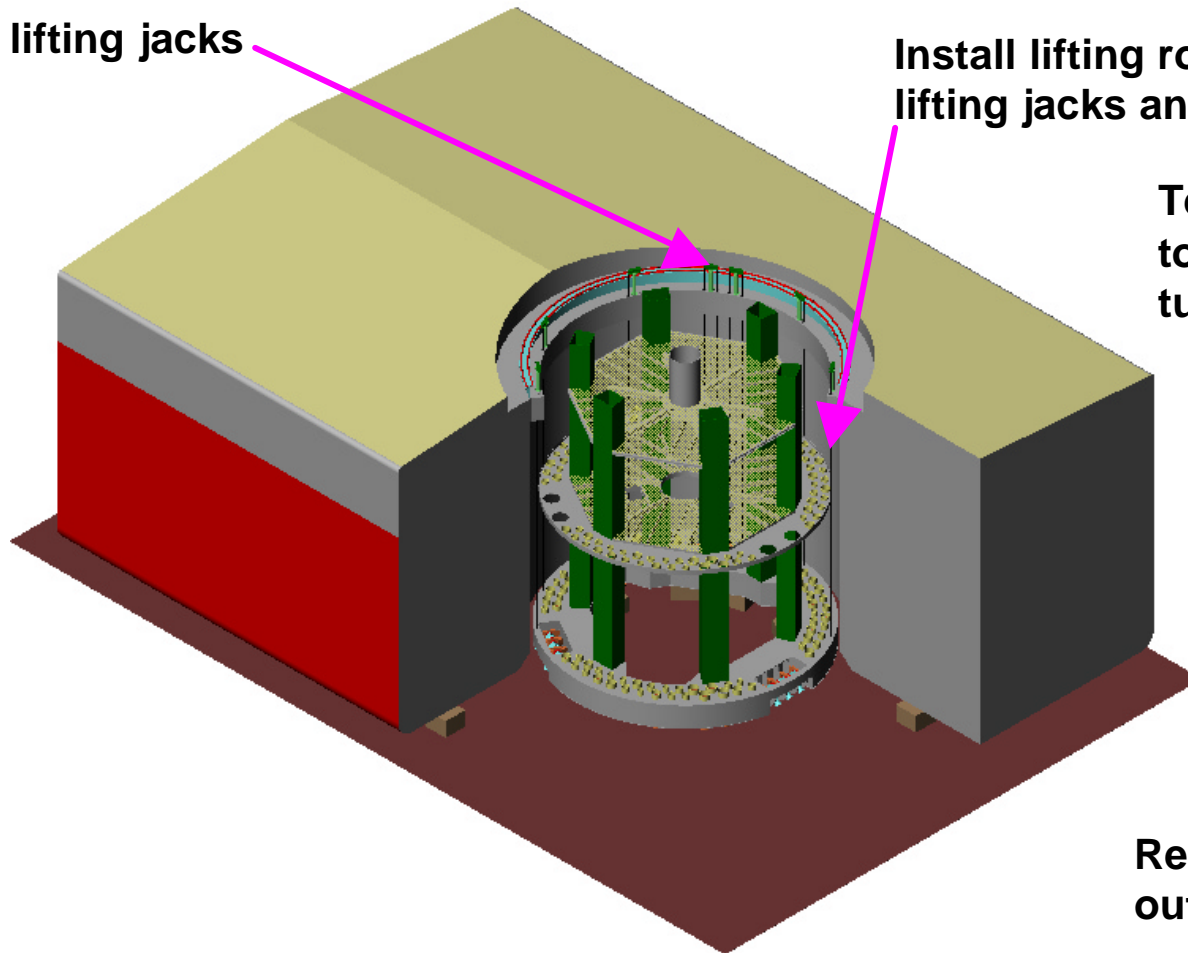


Heavy Lift Construction – 8 Vessel in drydock

Install lifting jacks

Install lifting rods between
lifting jacks and chain table

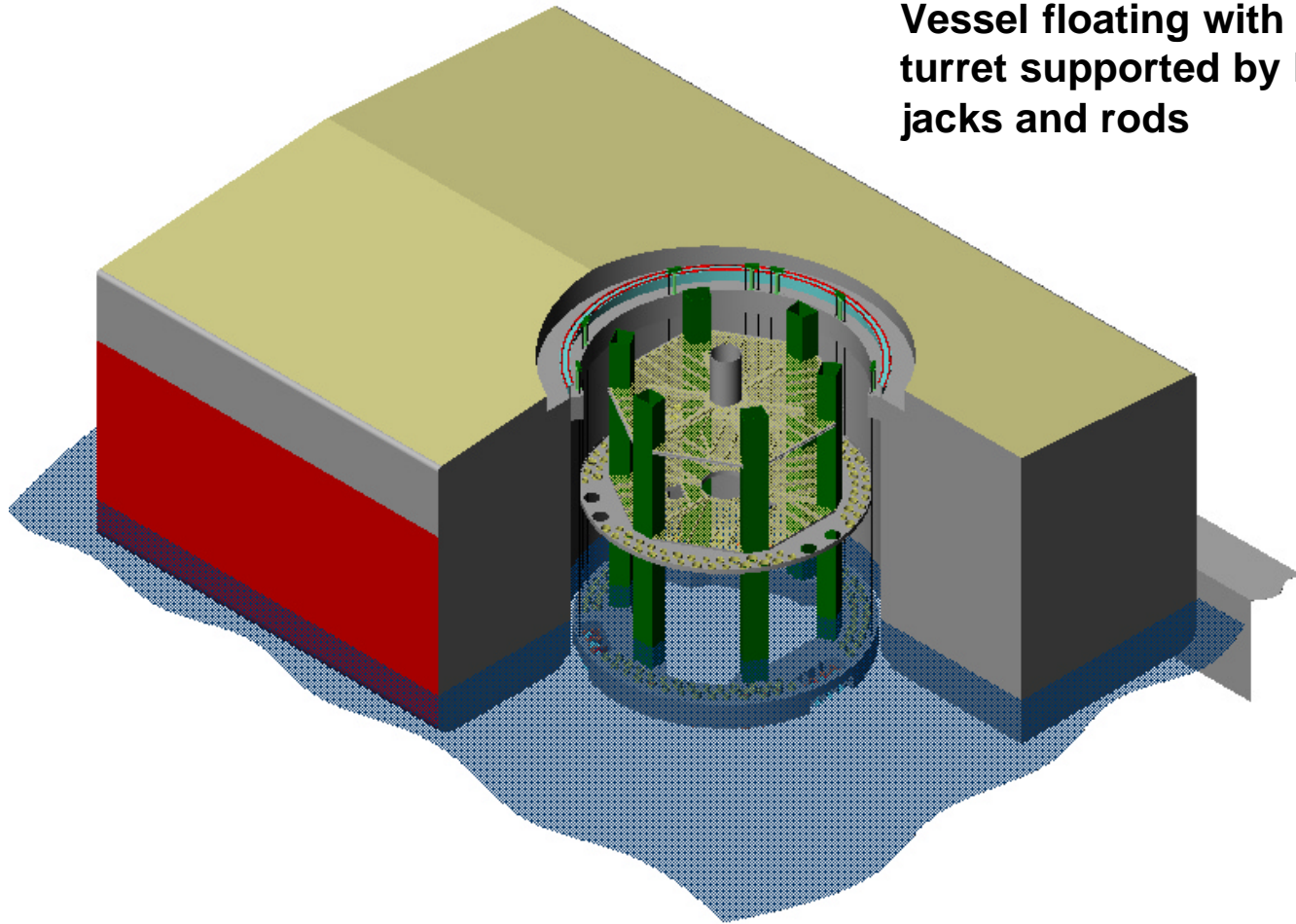
Tension rods
to carry lower
turret weight



Ready to float
out of drydock

Heavy Lift Construction – 9 Vessel floating dockside

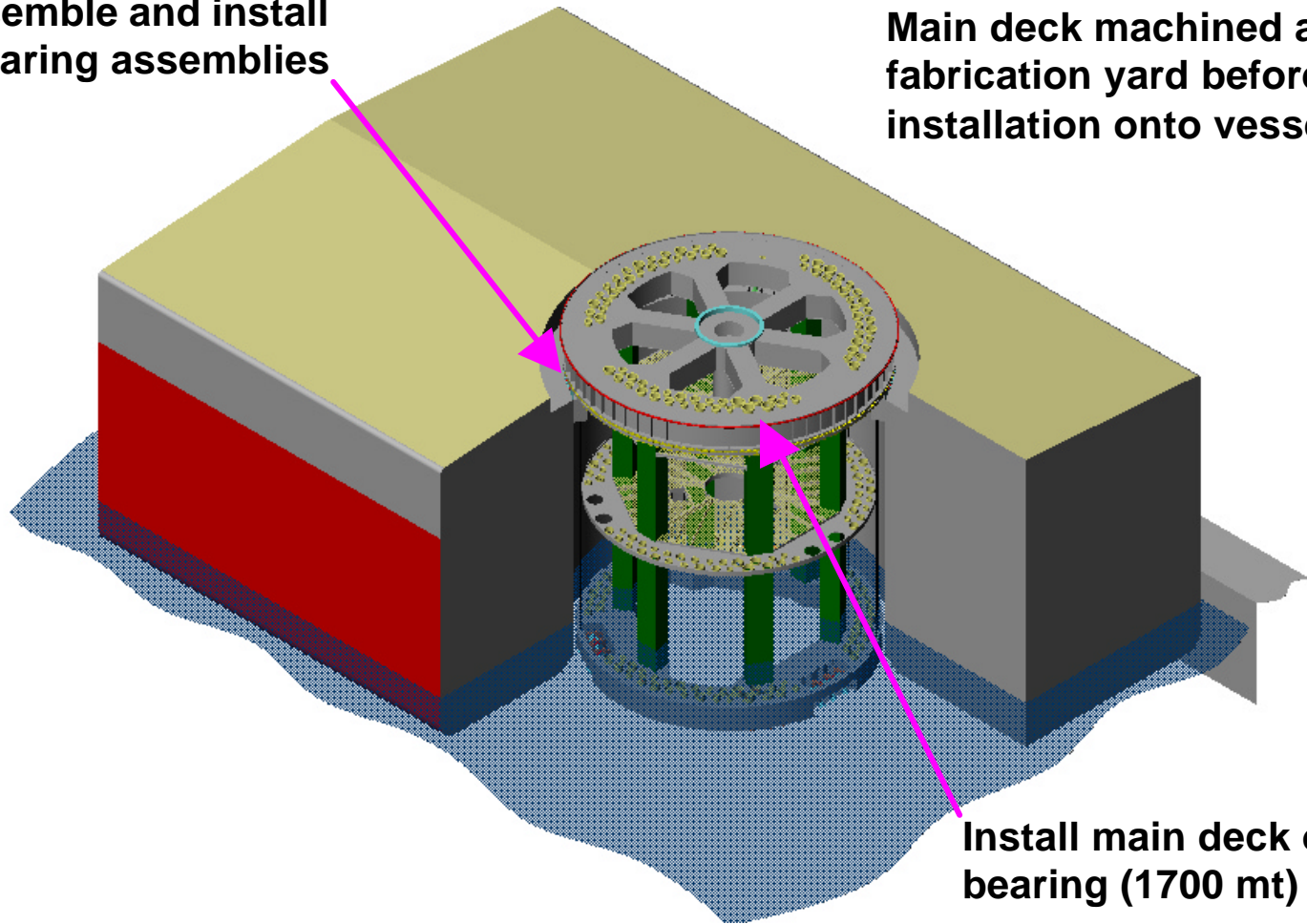
**Vessel floating with lower
turret supported by lifting
jacks and rods**



Heavy Lift Construction – 10 Vessel floating dockside

**Assemble and install
wheel bearing assemblies**

**Main deck machined at
fabrication yard before
installation onto vessel**



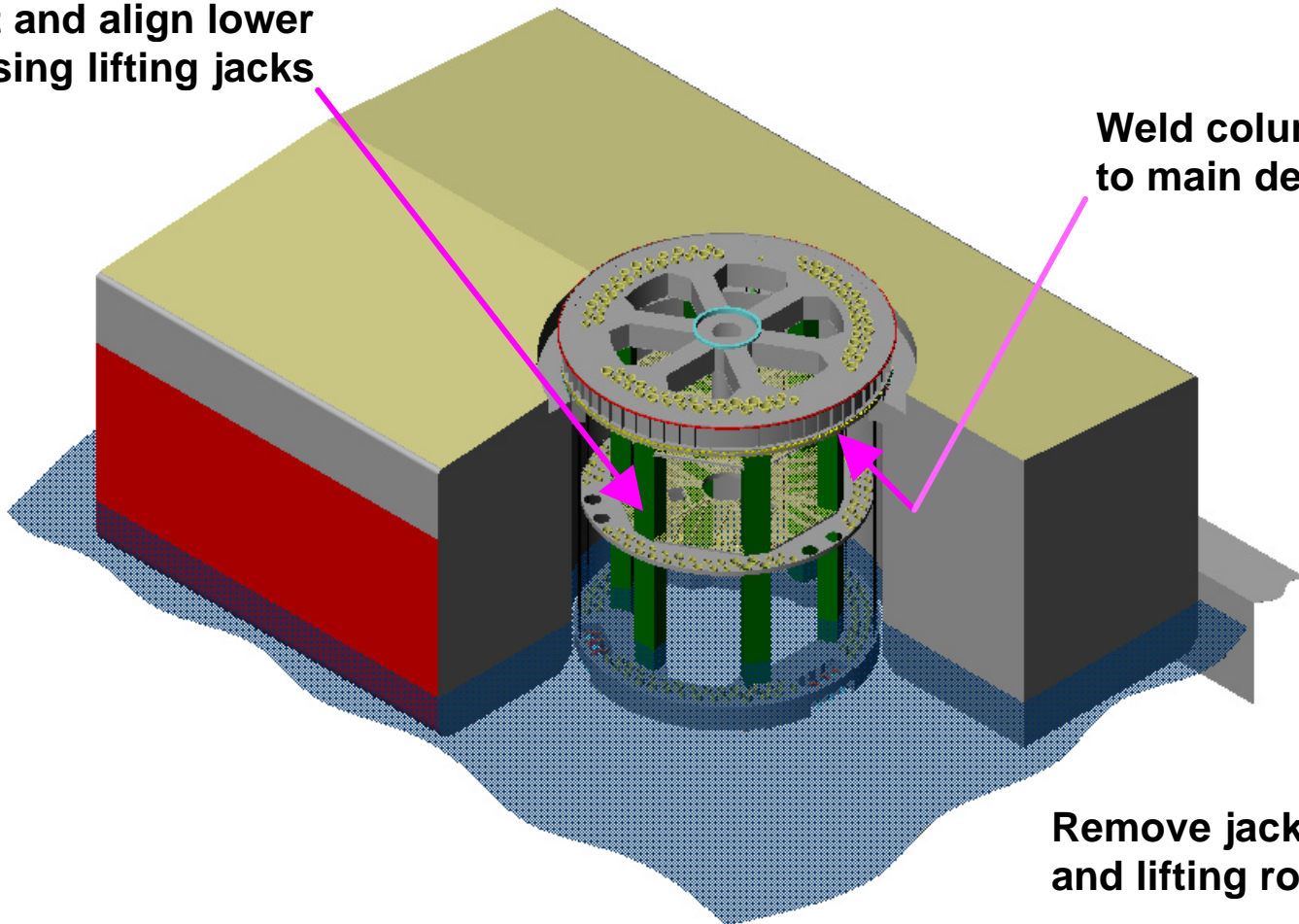
**Install main deck onto
bearing (1700 mt)**

Heavy Lift Construction – 11

Vessel floating dockside

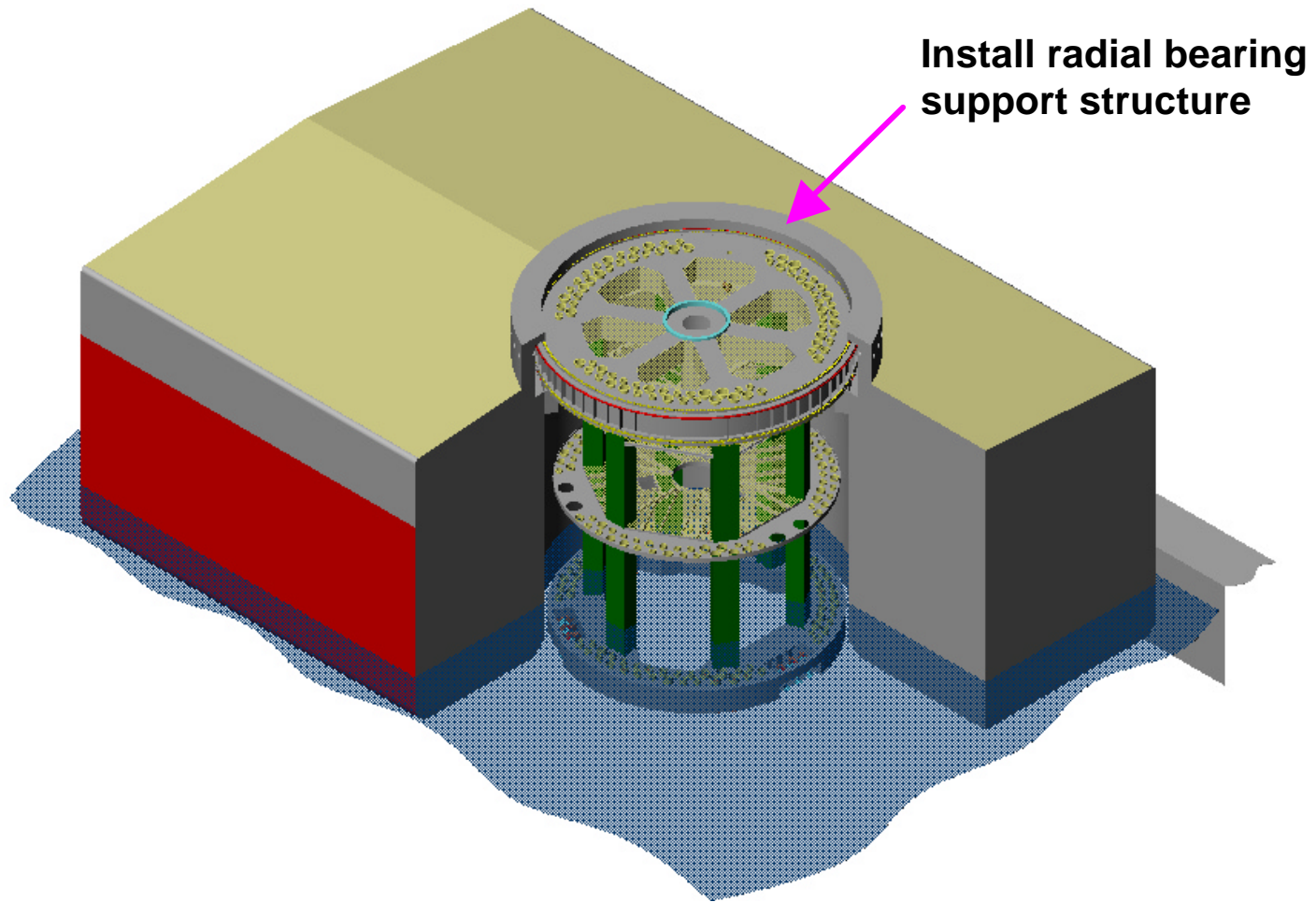
Lift and align lower turret using lifting jacks

Weld columns to main deck



Remove jacks and lifting rods

Heavy Lift Construction – 12 Vessel floating dockside

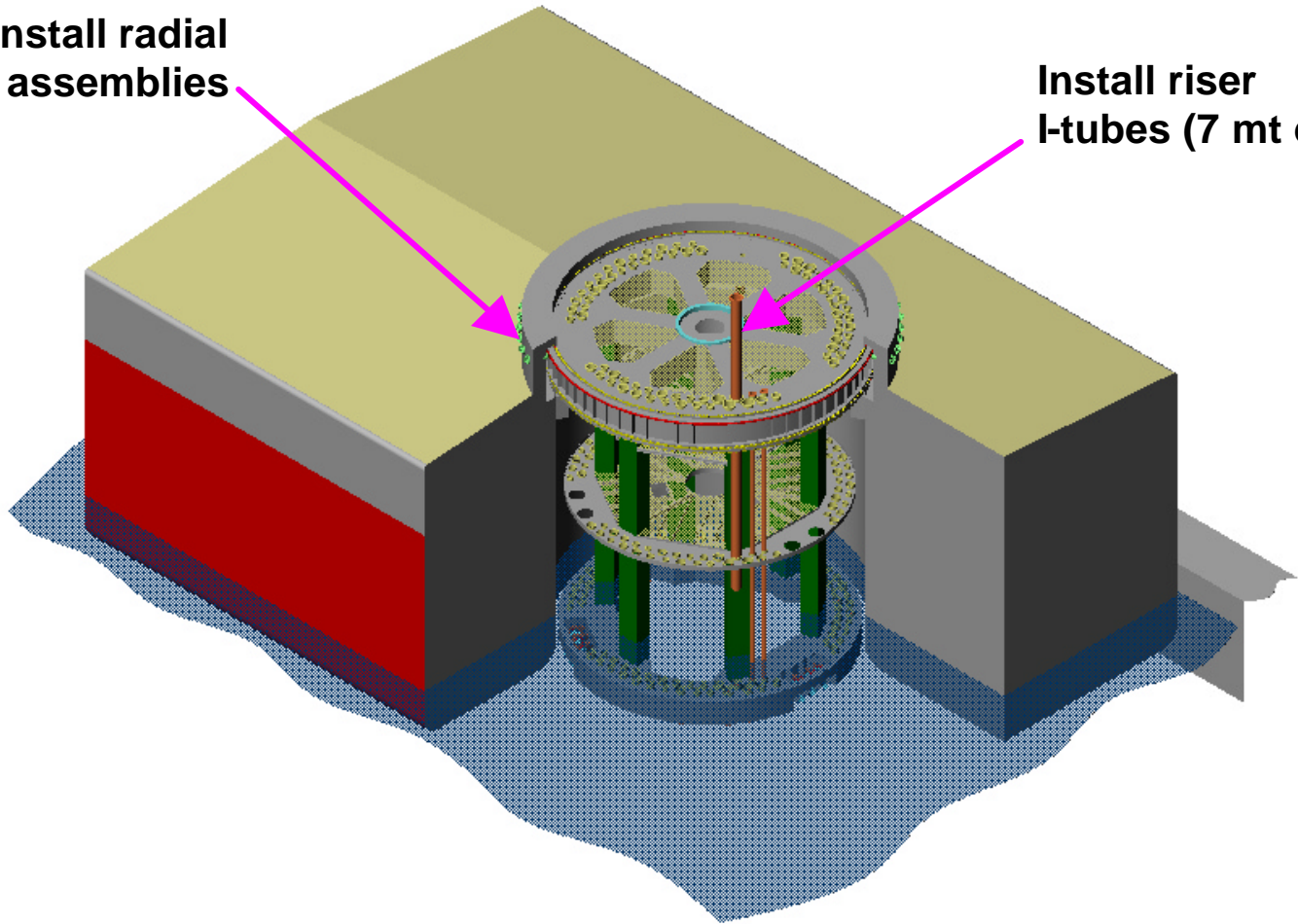


Heavy Lift Construction – 13

Vessel floating dockside

**Install radial
bearing assemblies**

**Install riser
I-tubes (7 mt ea)**

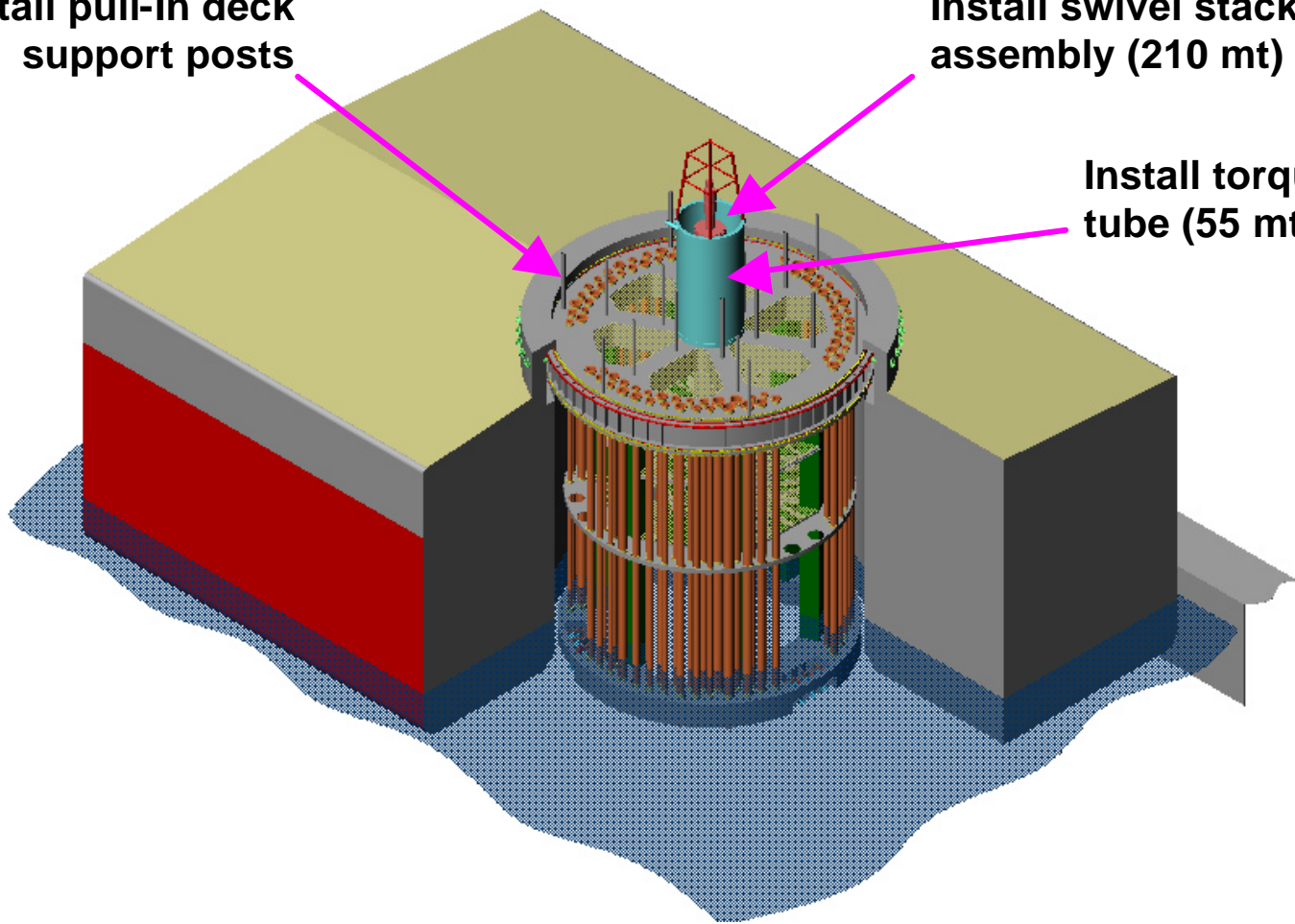


Heavy Lift Construction – 14 Vessel floating dockside

Install pull-In deck
support posts

Install swivel stack
assembly (210 mt)

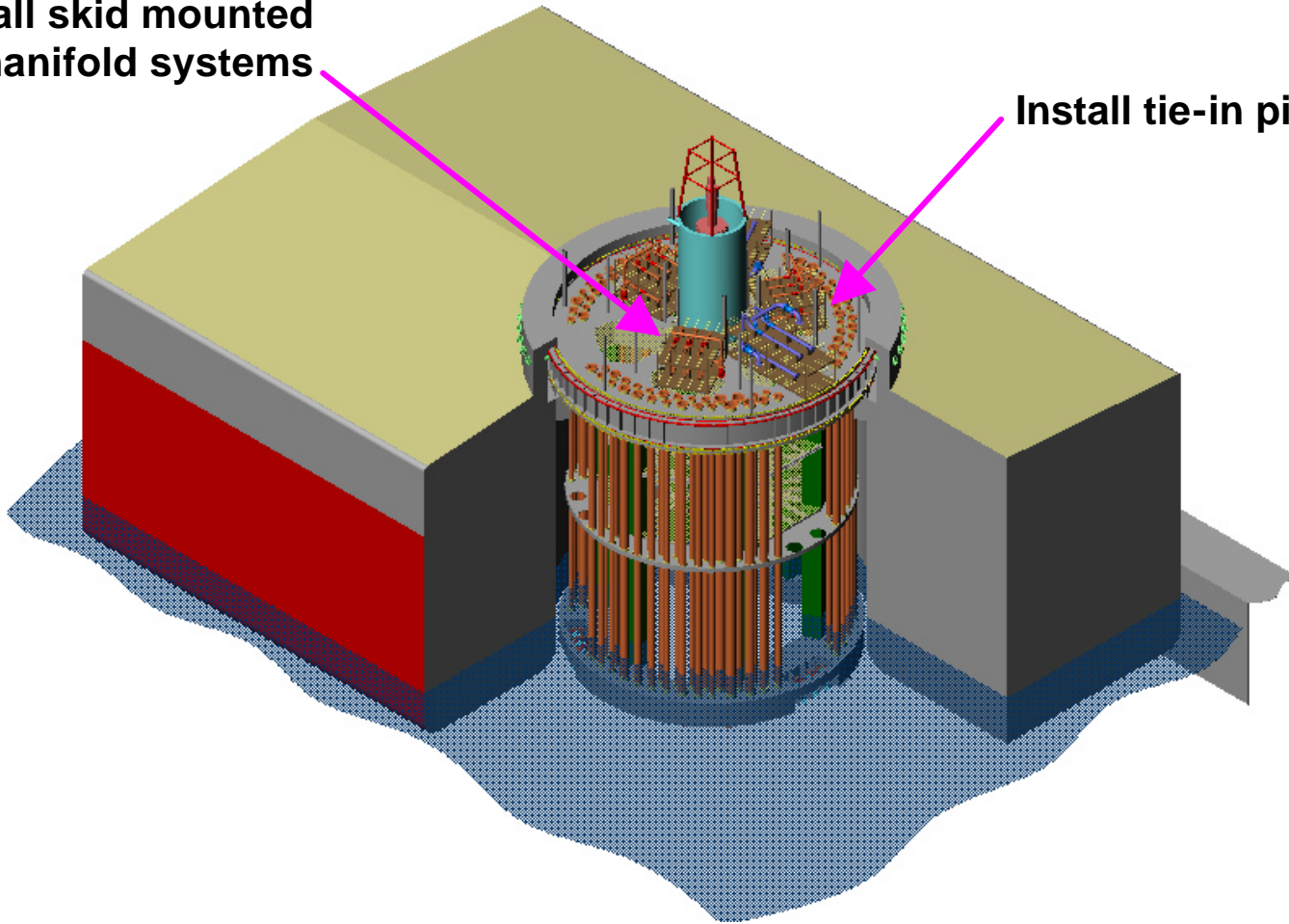
Install torque
tube (55 mt)



Heavy Lift Construction – 15 Vessel floating dockside

Install skid mounted
manifold systems

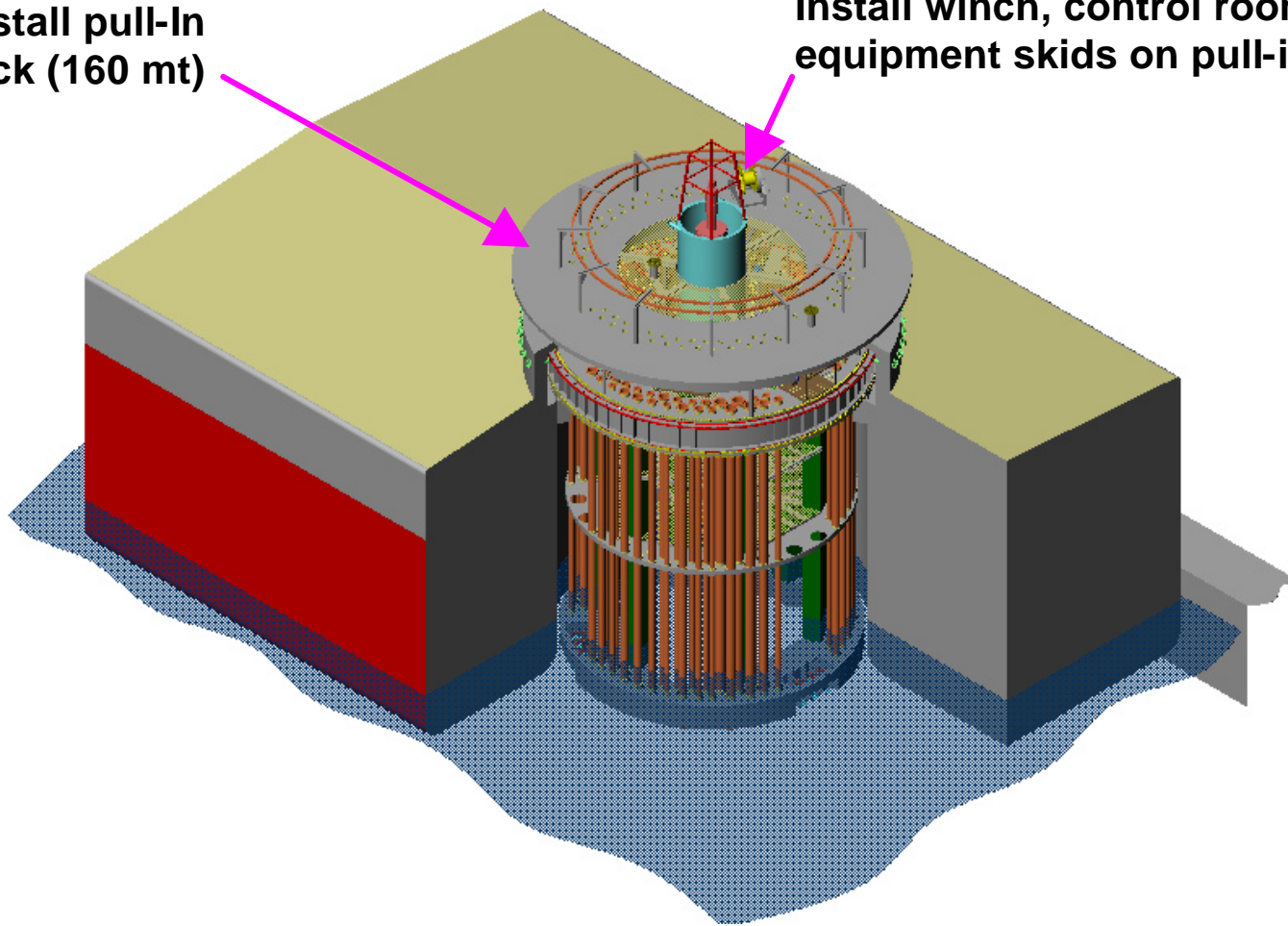
Install tie-in piping



Heavy Lift Construction – 16 Vessel floating dockside

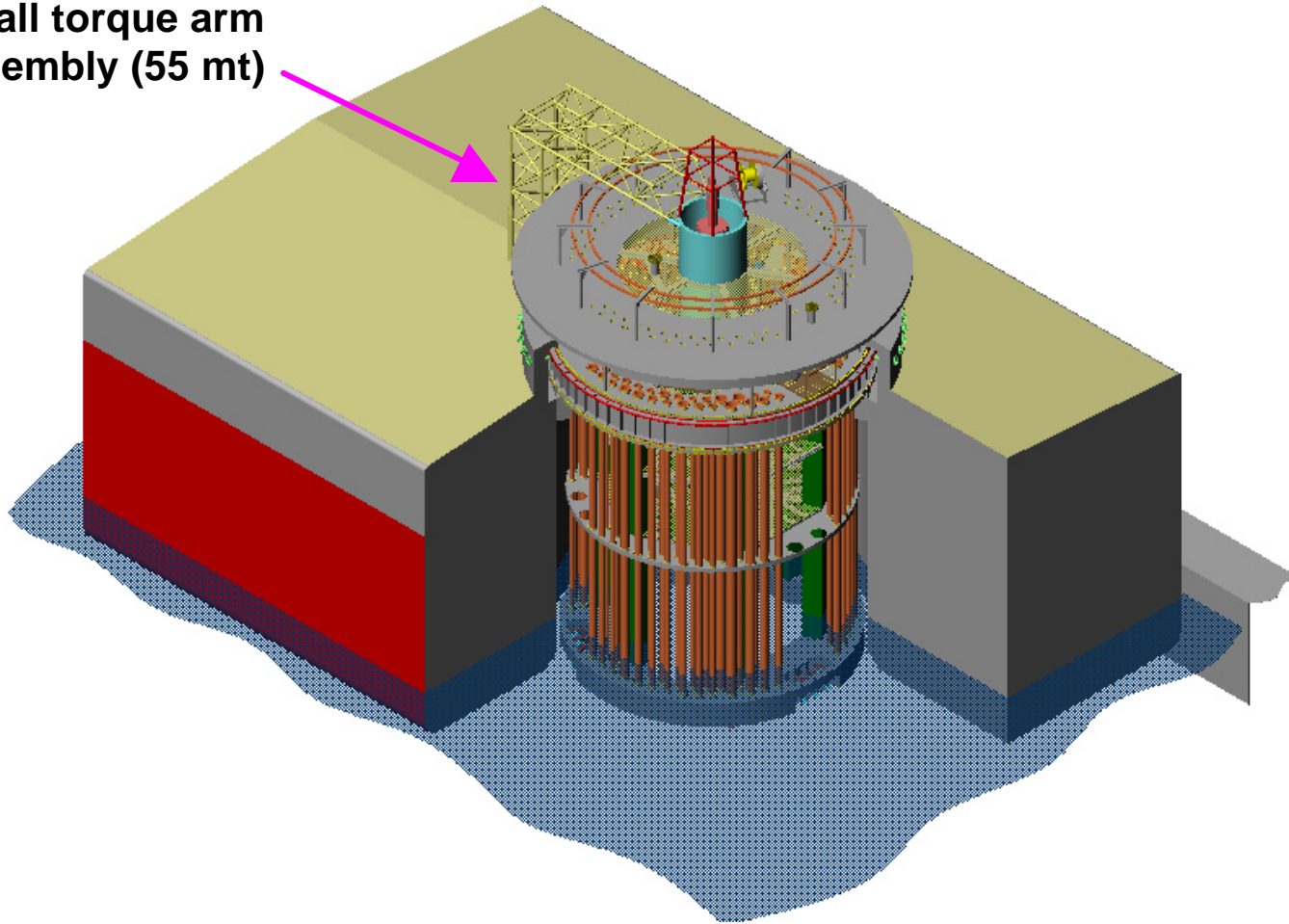
Install pull-In
deck (160 mt)

Install winch, control room and
equipment skids on pull-in deck



Heavy Lift Construction – 17 Vessel floating dockside

Install torque arm
assembly (55 mt)



Heavy Lift Construction - 18 Vessel floating dockside

