NEXT-100 Pressure Vessel, May 7, 2012

D. Shuman[1], S. Carcel[2], A. Martinez[2]

[1]Lawrence Berkeley National Laboratory(LBNL), [2] Instituto Physica de Corpuscular (IFIC)

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Table of Contents

Vessel Design simplified, Material chosen (S.S., 316Ti alloy).

- Torispheric heads identical - 4 nozzles each - extra capacity
- Head nozzles shortened - extensions will be used as needed
- Nozzle extensions and cover plates contain O-ring grooves and pumpout ports
- 316Ti (EN1.4571) - best radiopurity (200 mBq/kg), popular alloy, plate only (ASME, div 1 only)

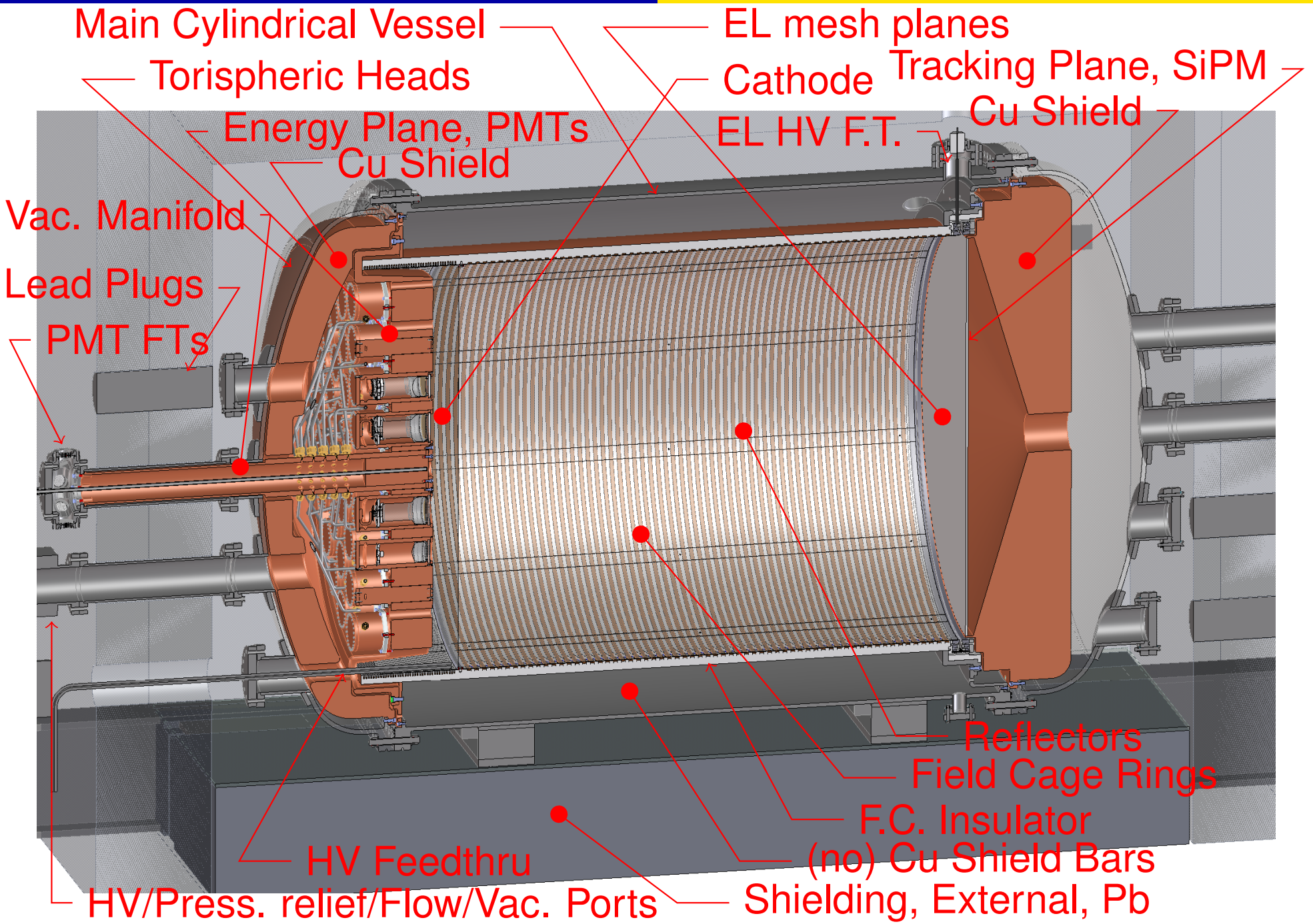
Manufacturer chosen - Movesa , Madrid

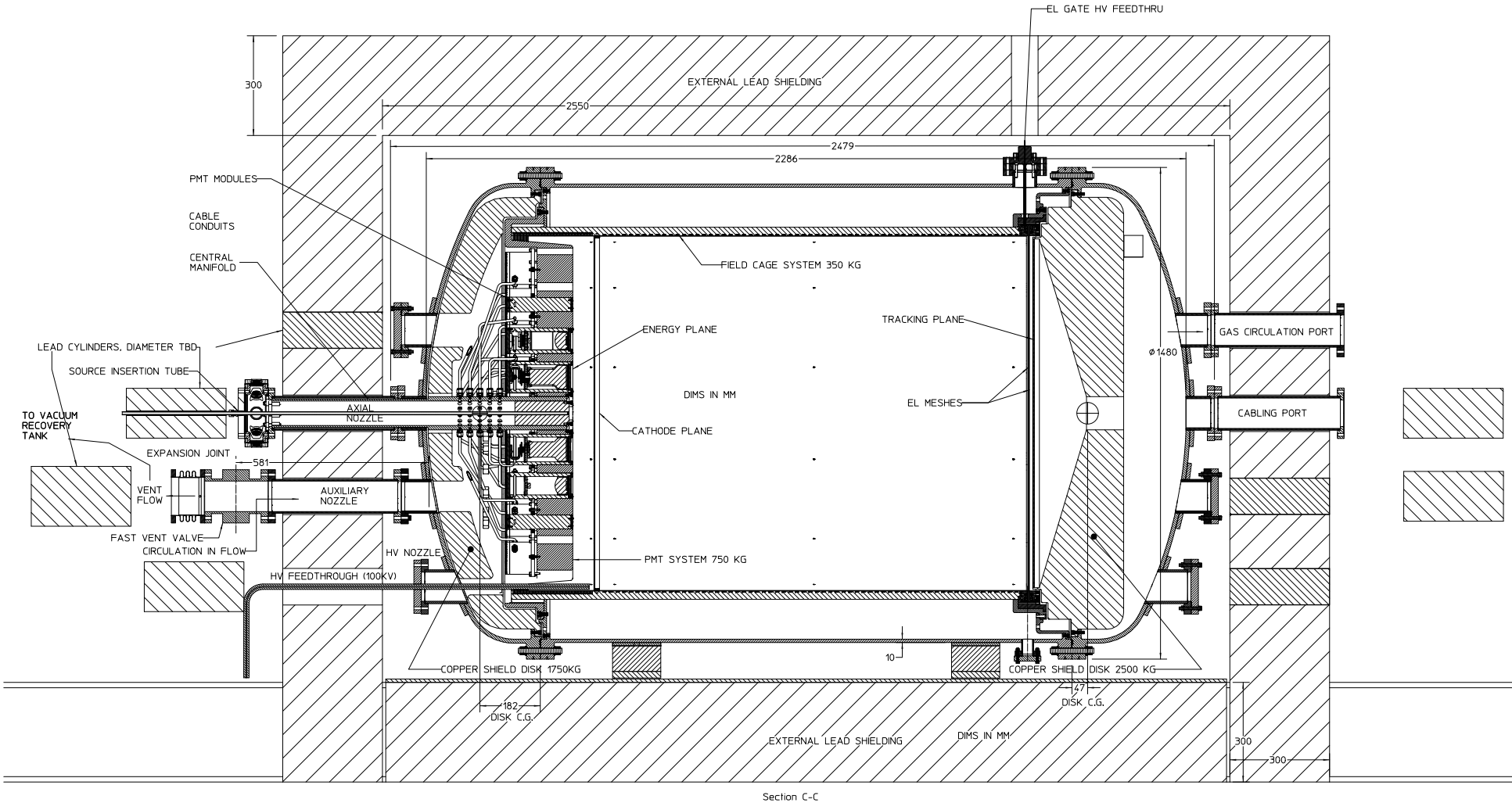
- Site visit Fall 2011 - one other mfr. visited
- Capable and versatile mfr. - boilers, reactors for food and pharmaceutical, turnkey processing systems
- Separate facilities for stainless steel vs carbon steel
- Convenient for frequent vists during fabrication

User Design Specification Completed (ASME)

- Specifies all vessel requirements and operating conditions
- Now goes to Mfr. and Certifying Authority for review and approval
- Mfr. will recalculate - final design must be agreed upon
- Head thickness may meet EU code, but not ASME

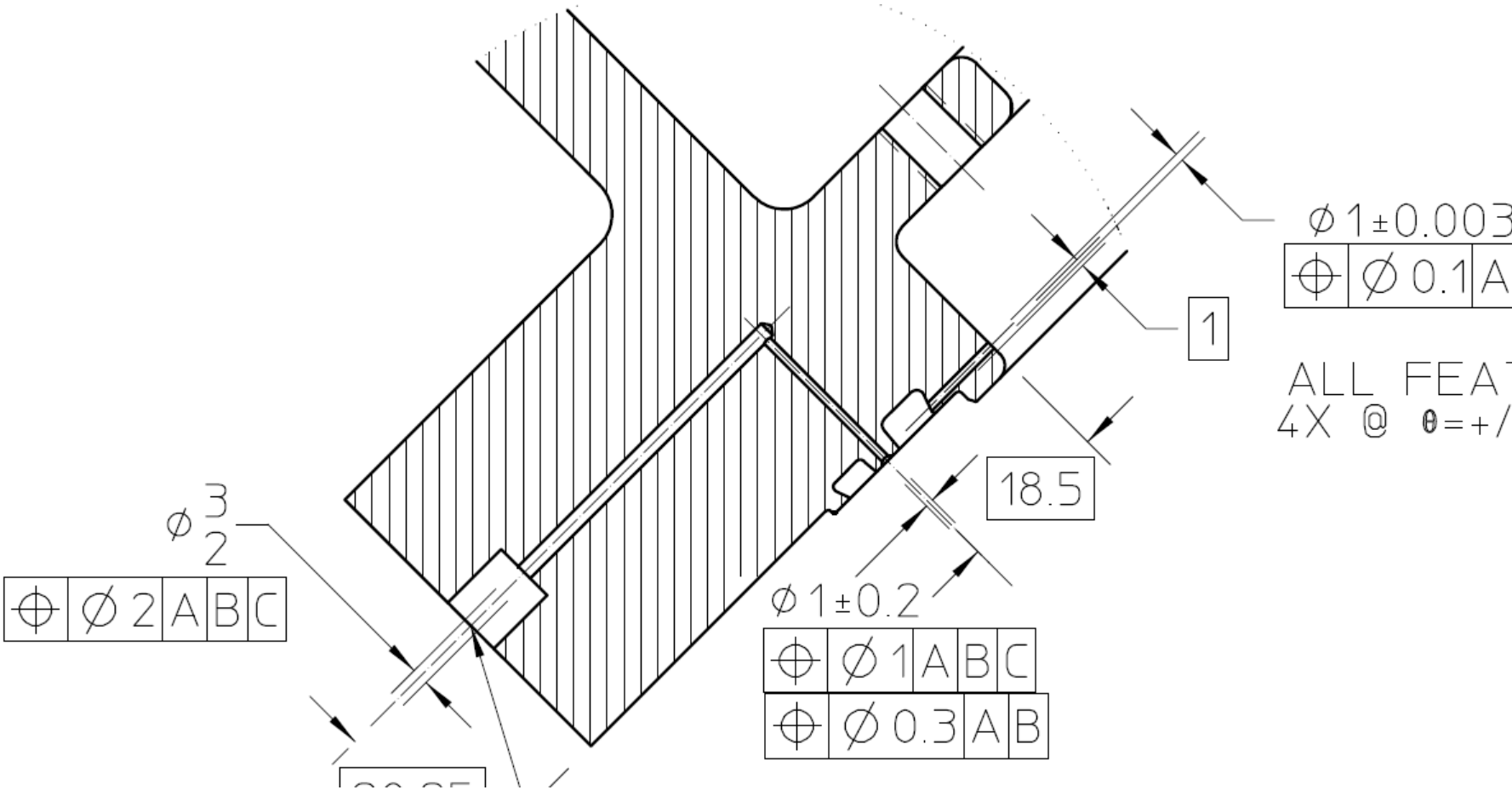
Parameter	qty	units
Active Volume Radius	53	cm
Active Volume Length	130	cm
Maximum Operating Pressure (MOP) (differential)	14.0	bar
Maximum Allowable Working pressure (MAWP) (differential)	15.4	bar
Minimum Allowable Pressure (differential)	1.5	bar
Inner diameter	136	cm
Outer Diameter, Vessel	138	cm
Outer Diameter, Flanges	148	cm
Length, inside inner shielding	2.26	m
Length, end to end, axial	2.48	m
Vessel Material, Austenitic Stainless Steel, Alloy	316Ti	
Cylindrical Vessel Wall thickness	10	mm
Torispheric Head Wall thickness	10.5	mm
Flange thickness, head to vessel (each)	4.15	cm
Bolt Diameter (Inconel 718), head to vessel flanges	16	mm
Bolt length, head to vessel flanges	11	cm
Number of Bolts, each head to vessel flange	132	
Mass, Vessel and both heads	1200	kg
Mass, Internal copper shielding, total (12 cm)	10000	kg
Total Detector and Vessel Weight	12000	kg

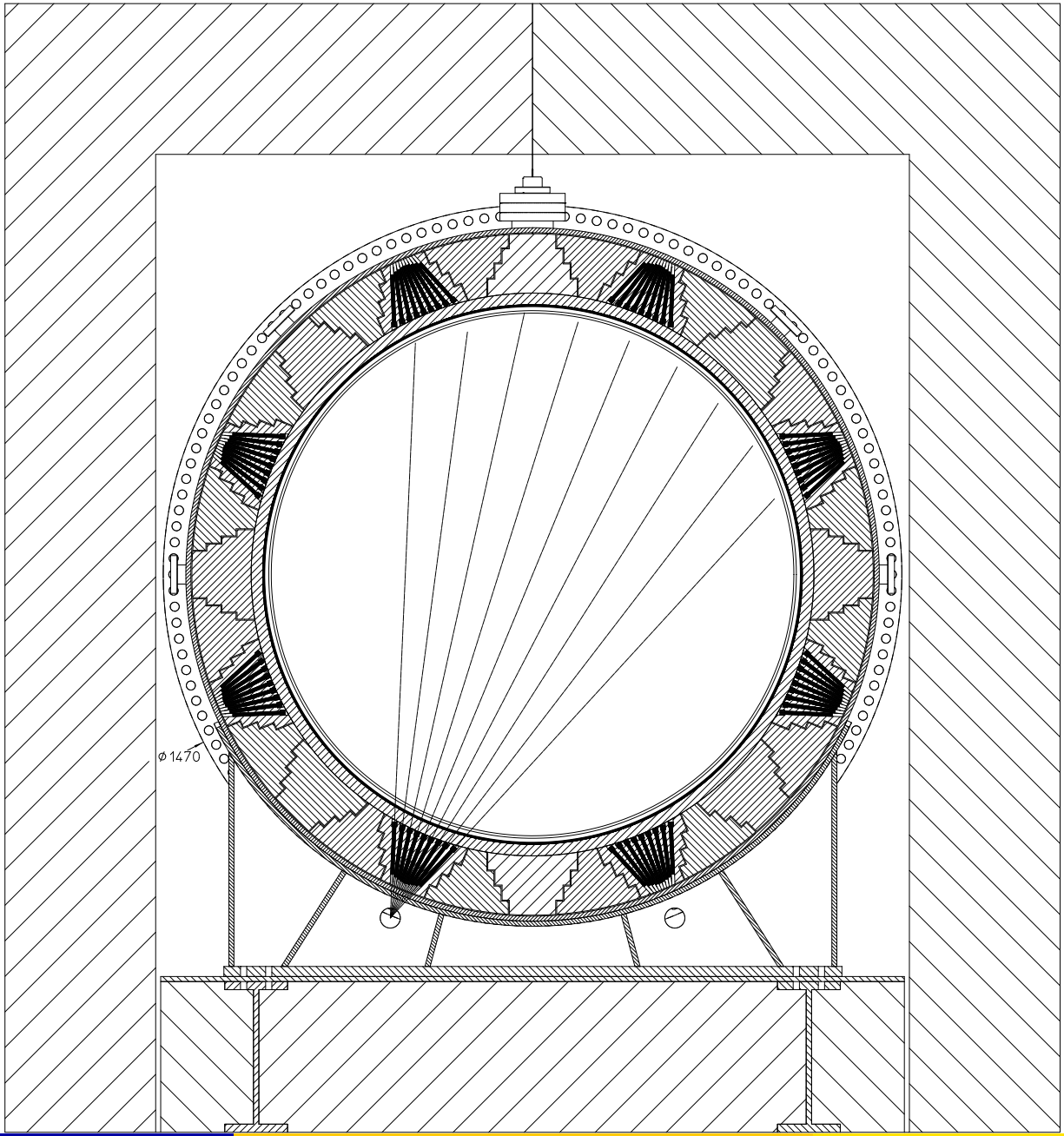

Main Cylindrical Vessel
Torispheric Heads
Energy Plane, PMTs
Cu Shield
Vac. Manifold
Lead Plugs
PMT FTs
EL mesh planes
Cathode
EL HV F.T.
Tracking Plane, SiPM
Cu Shield
Reflectors
Field Cage Rings
F.C. Insulator
(no) Cu Shield Bars
Shielding, External, Pb
HV Feedthru
HV/Press. relief/Flow/Vac. Ports

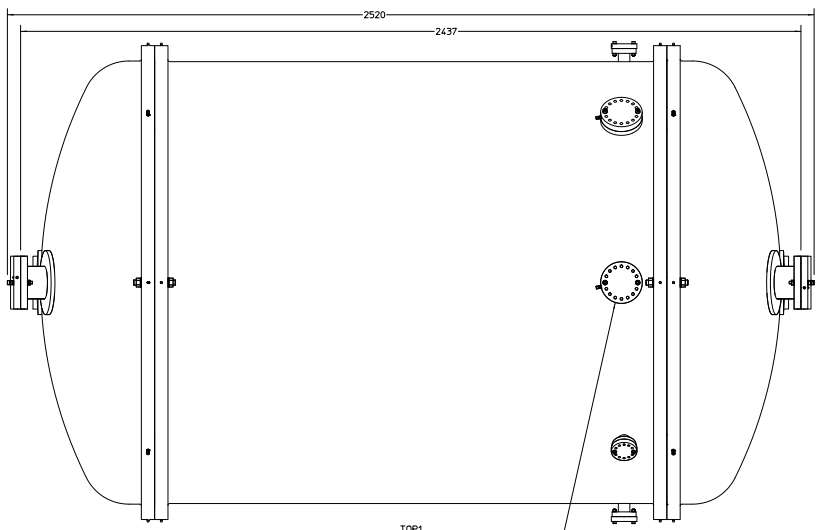

EL GATE HV FEEDTHRU
EXTERNAL LEAD SHIELDING
300
2550
2479
2286
PMT MODULES
CABLE CONDUITS
CENTRAL MANIFOLD
FIELD CAGE SYSTEM 350 KG
TRACKING PLANE
ENERGY PLANE
GAS CIRCULATION PORT
ø1480
LEAD CYLINDERS, DIAMETER TBD
SOURCE INSERTION TUBE
DIMS IN MM
EL MESHES
CABLING PORT
TO VACUUM RECOVERY TANK
AXIAL NOZZLE
CATHODE PLANE
EXPANSION JOINT
581
VENT FLOW
AUXILIARY NOZZLE
FAST VENT VALVE
CIRCULATION IN FLOW
HV NOZZLE
PMT SYSTEM 750 KG
HV FEEDTHROUGH (100KV)
10
COPPER SHIELD DISK 1750KG
COPPER SHIELD DISK 2500 KG
47
DISK C.G.
182
DISK C.G.
EXTERNAL LEAD SHIELDING
DIMS IN MM
300
300

Section C-C

Double O-ring leak check port moved to heads, (no alignment issue)

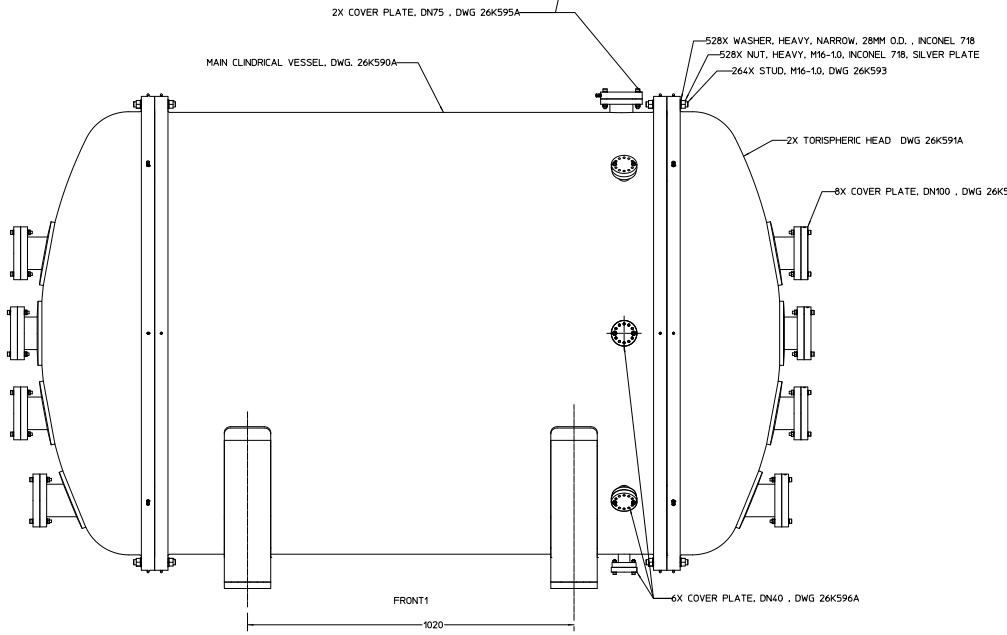


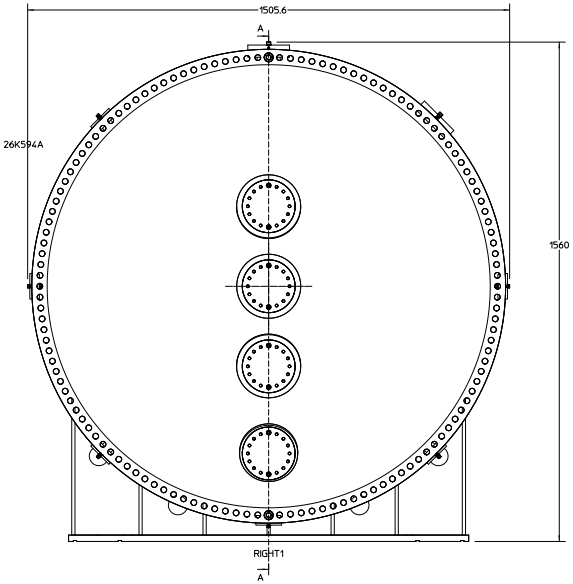

ϕ1470



GENERAL NOTES:

1. THIS DRAWING IS A PART OF NEXT-100-PV1 USER DESIGN SPECIFICATION
2. THIS DRAWING IS PRELIMINARY, AND SETS FORTH BOTH REQUIRED DIMENSIONS, AND PRELIMINARY DIMENSIONS TO BE VERIFIED BY MANUFACTURER.
3. ALL PARTS TO BE FABRICATED, INSPECTED AND TESTED IN ACCORDANCE WITH ASME BOILER AND PRESSURE VESSEL CODE SECTION VIII, DIV. 1 OR EU EQUIVALENT.
4. ADDITIONAL REQUIREMENTS APPLY CONCERNING CLEANING, PREPARATION, INSPECTION, WELDING, HEAT TREATING.
5. VESSEL IS FOR BOTH MEDIUM PRESSURE (15.4 BAR) AND HIGH VACUUM (10**-6 TORR) SERVICE.
6. VESSEL SHALL BE DELIVERED IN CLEAN CONDITION, SERVICEABLE FOR HIGH VACUUM SERVICE





VER	AUTHOR	APPROVER	DATE	CHANGE DESCRIPTION
A	dtshuman			INITIAL VERSION (NO REVISION)

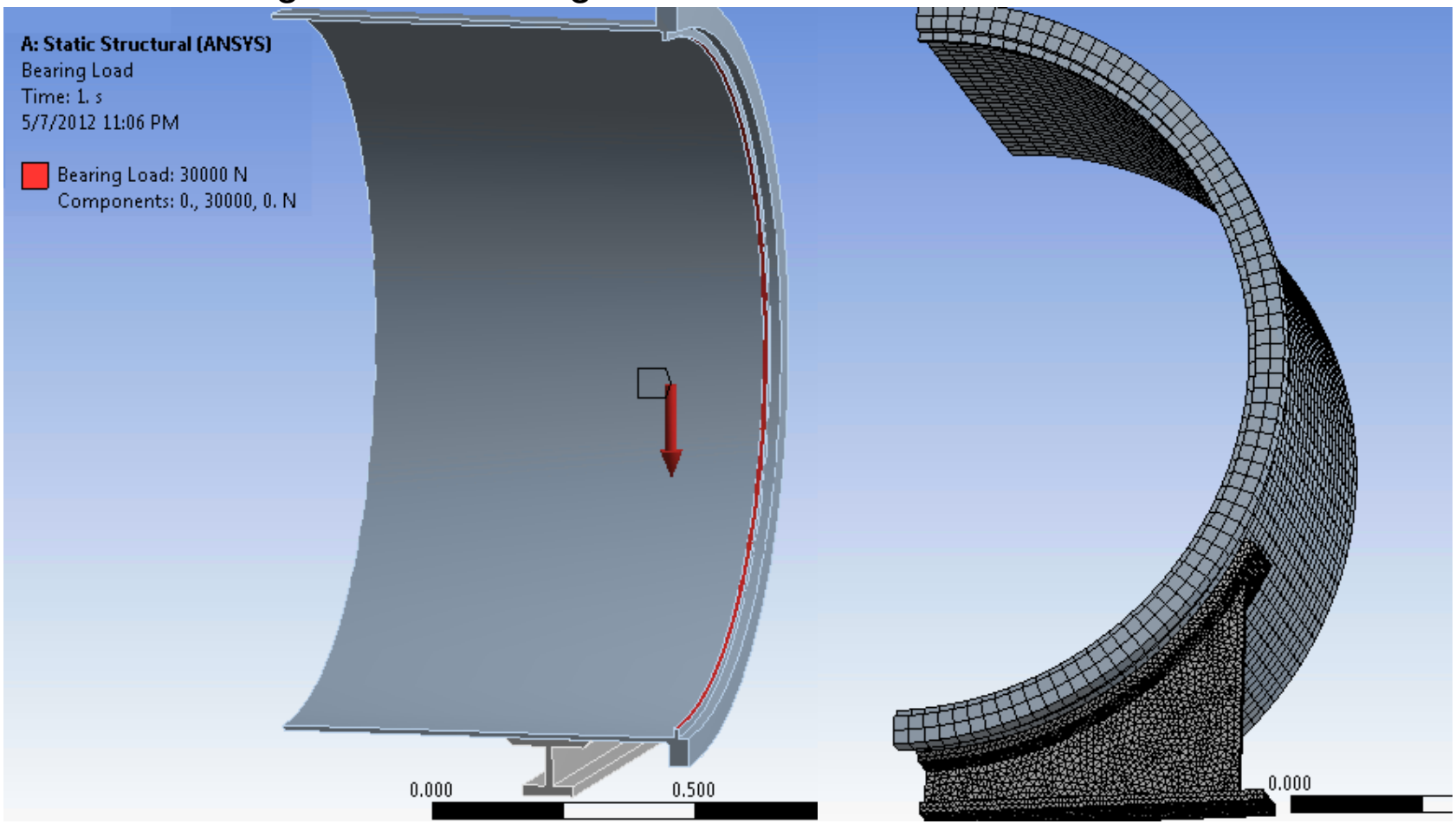
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES:
X ± .05 .XX ± .01 .XXX ± .005
FRACTIONS: ± 1/64
ANGLES: ± 0.2°
MACH. SURFS.: 125 µin
BREAK EDGES .016 MAX. ON MACHINED MDNS
REMOVE BURRS, WELD SPLATTER & LOOSE SCALE

PROJECT NAME:
PROJECT NUMBER:
SCALE: 1 : 5 RP 314 9
THIRD ANGLE PROJECTION

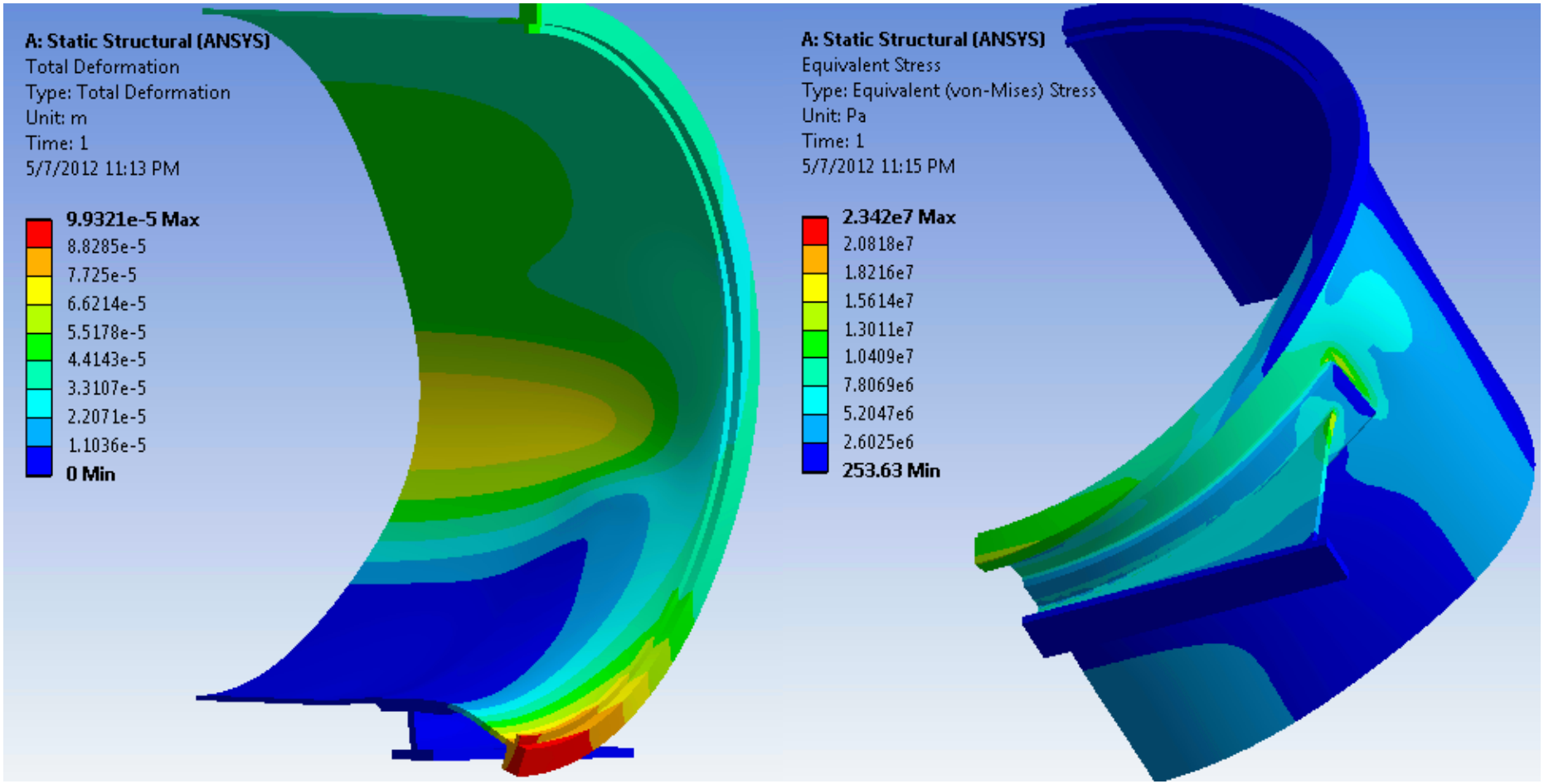
ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY
UNIVERSITY OF CALIFORNIA
NEXT-100 XENON TIME PROJECTION CHAMBER
PRESSURE VESSEL - VESSEL
VESSEL ASSEMBLY
SHEET 1 OF 2 SIZE: E DWG NO: 26K589 VER A

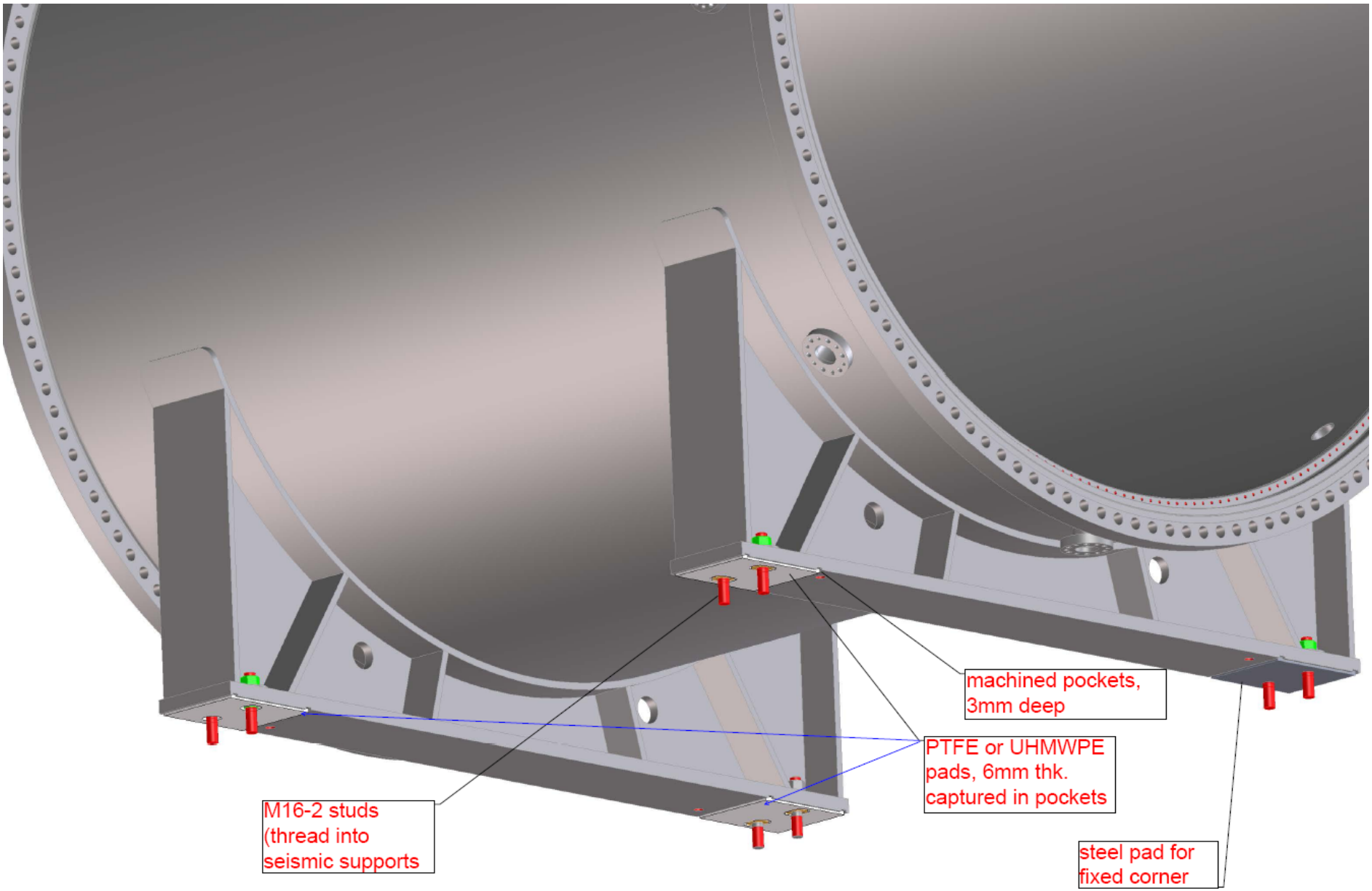
Is there significant stress and deflection from Copper shielding bars?

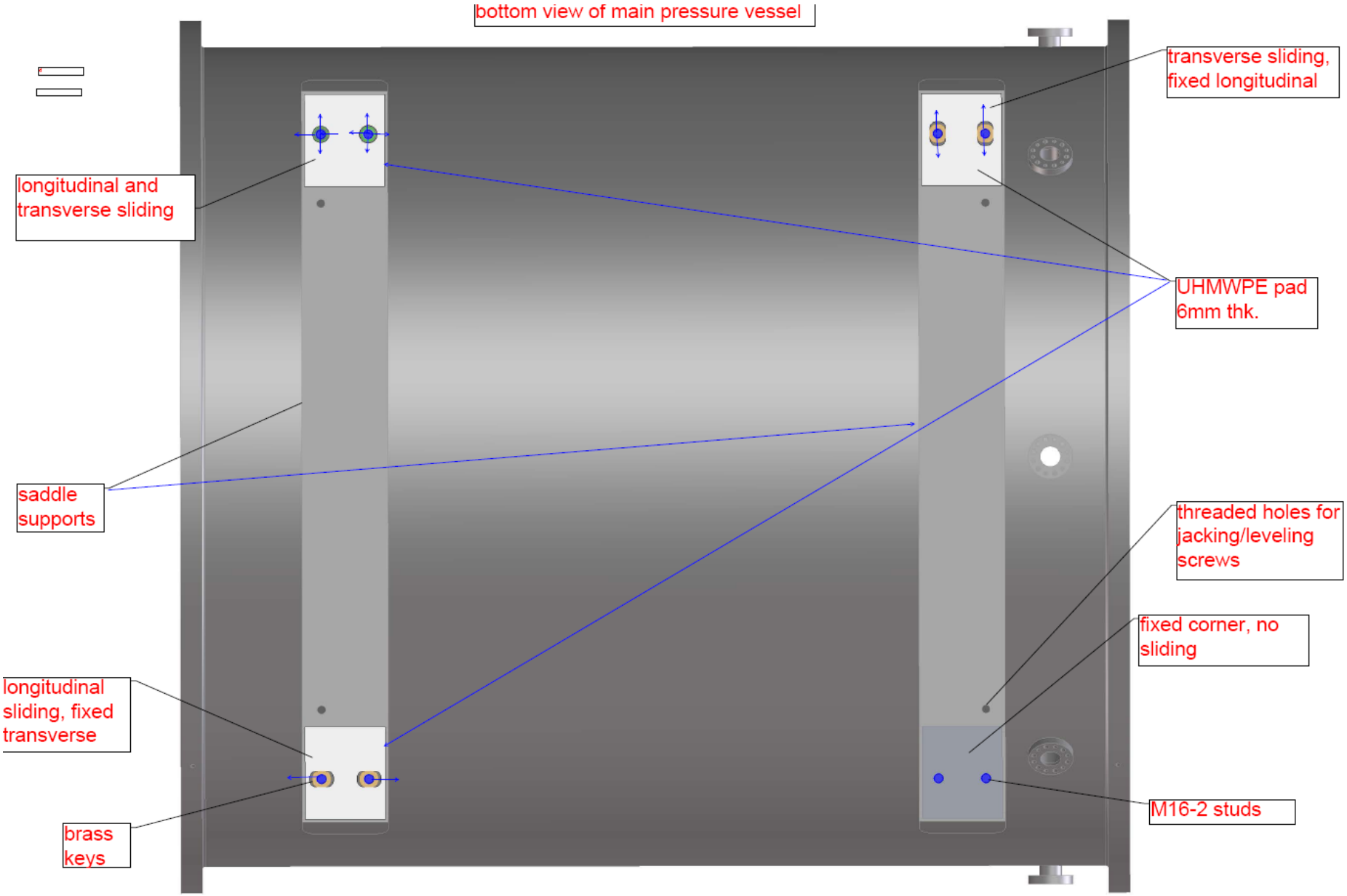
Load= 12000kg total both flanges

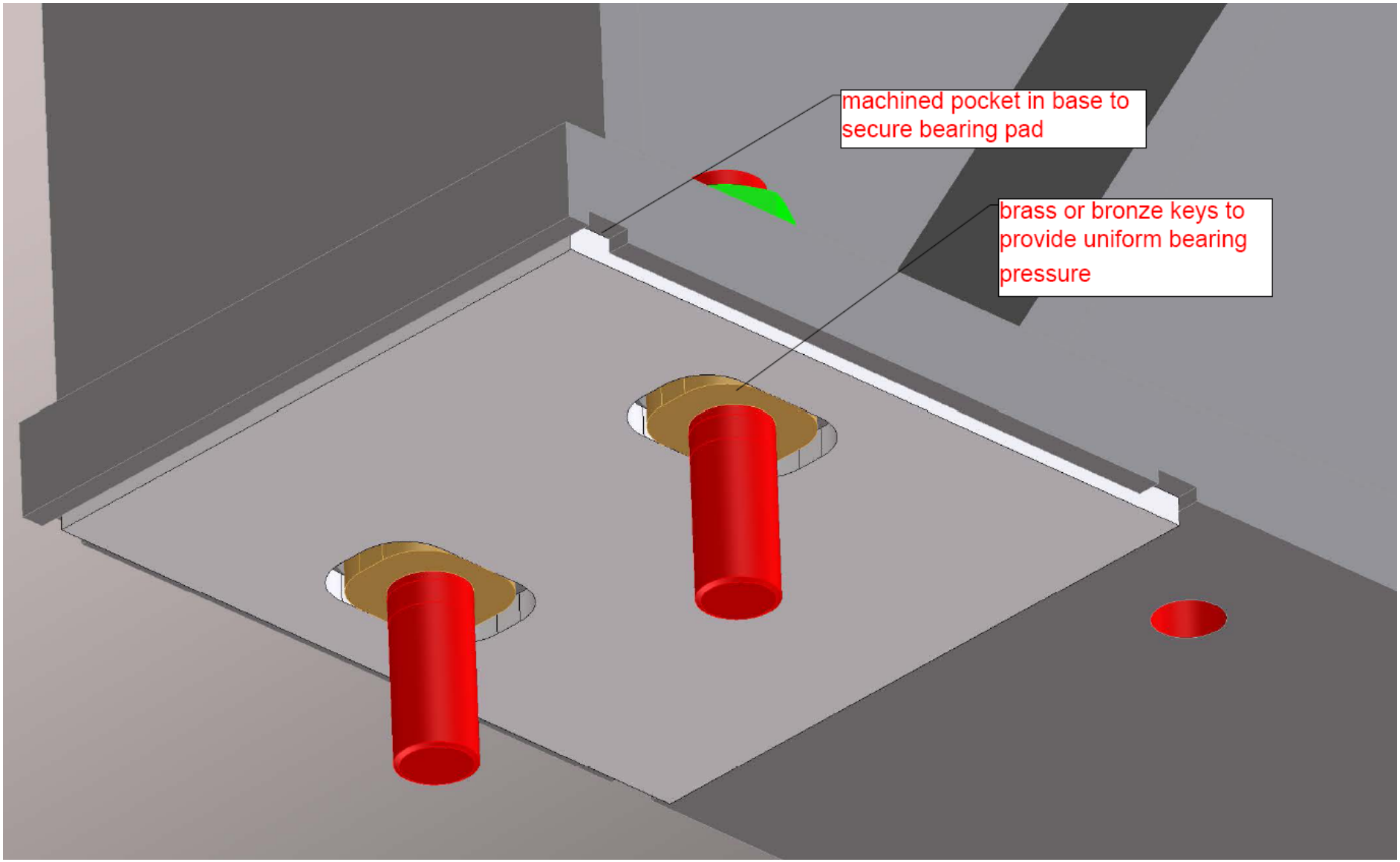


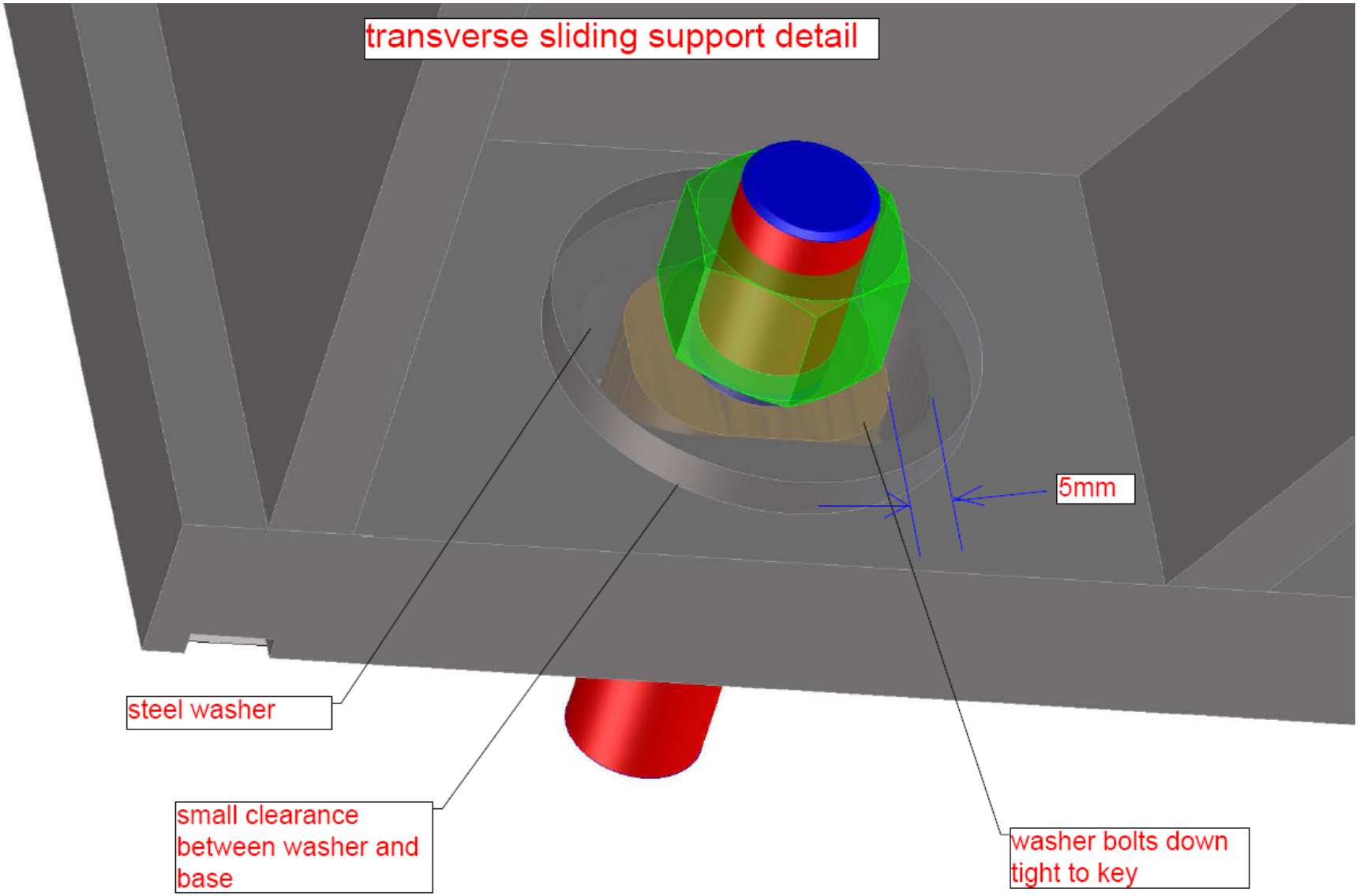
Deflection (0.1mm) and stress (2.E7 Pa) are minimimal (14.E7 Pa max allowable)

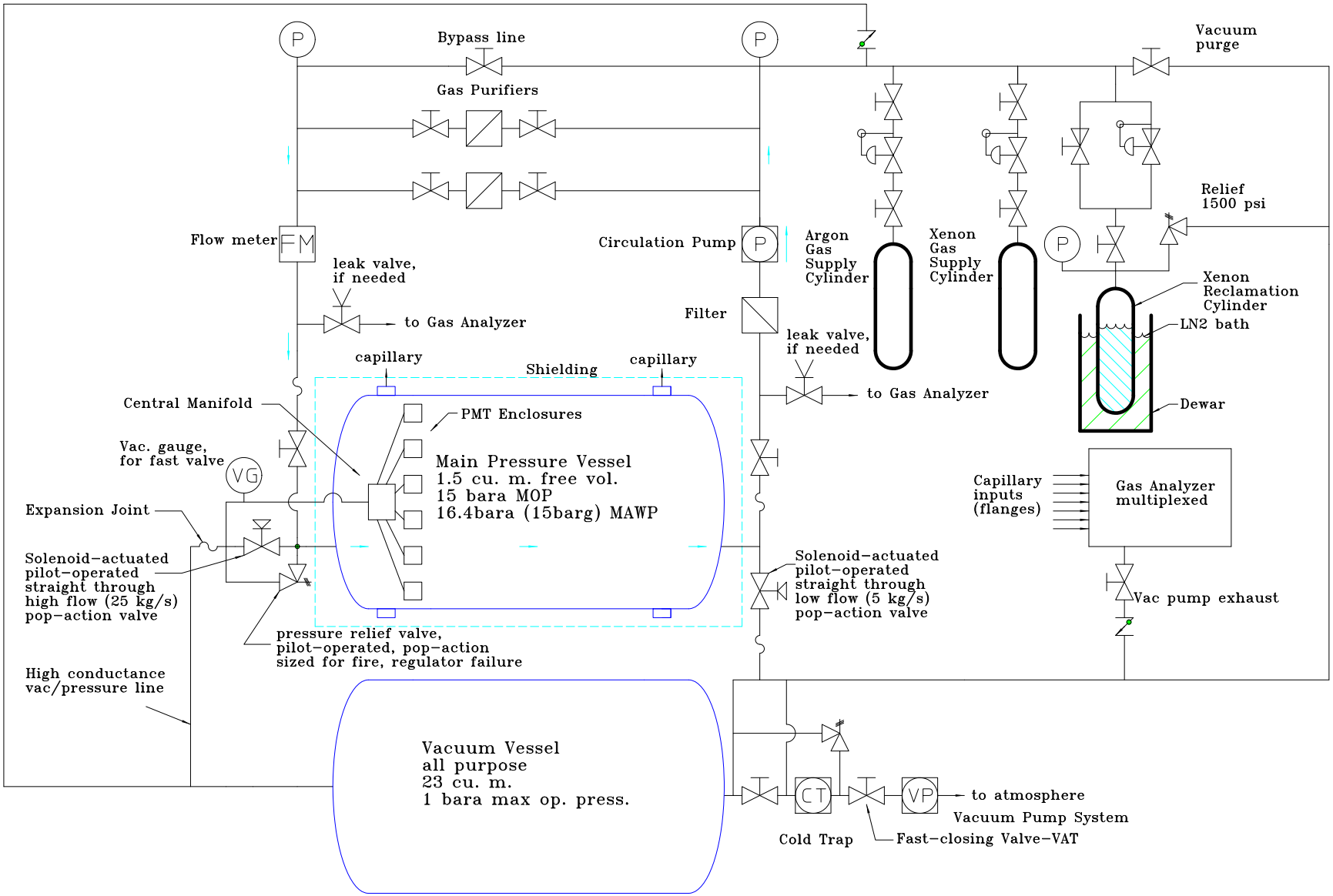



machined pockets,
3mm deep
PTFE or UHMWPE
pads, 6mm thk.
captured in pockets
M16-2 studs
(thread into
seismic supports
steel pad for
fixed corner

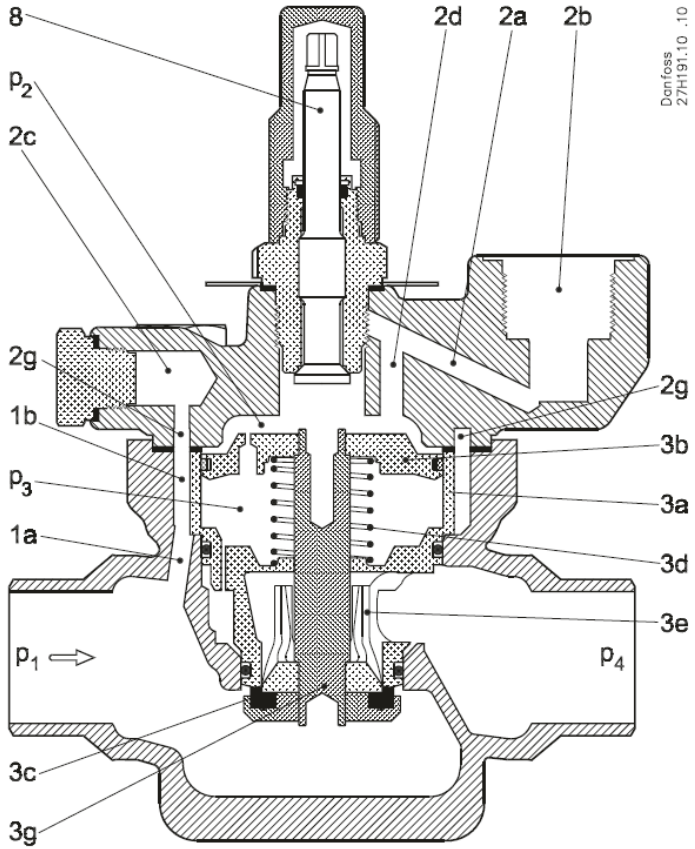

bottom view of main pressure vessel
transverse sliding, fixed longitudinal
longitudinal and transverse sliding
UHMWPE pad 6mm thk.
saddle supports
threaded holes for jacking/leveling screws
fixed corner, no sliding
longitudinal sliding, fixed transverse
M16-2 studs
brass keys


machined pocket in base to secure bearing pad
brass or bronze keys to provide uniform bearing pressure


transverse sliding support detail
5mm
steel washer
small clearance between washer and base
washer bolts down tight to key

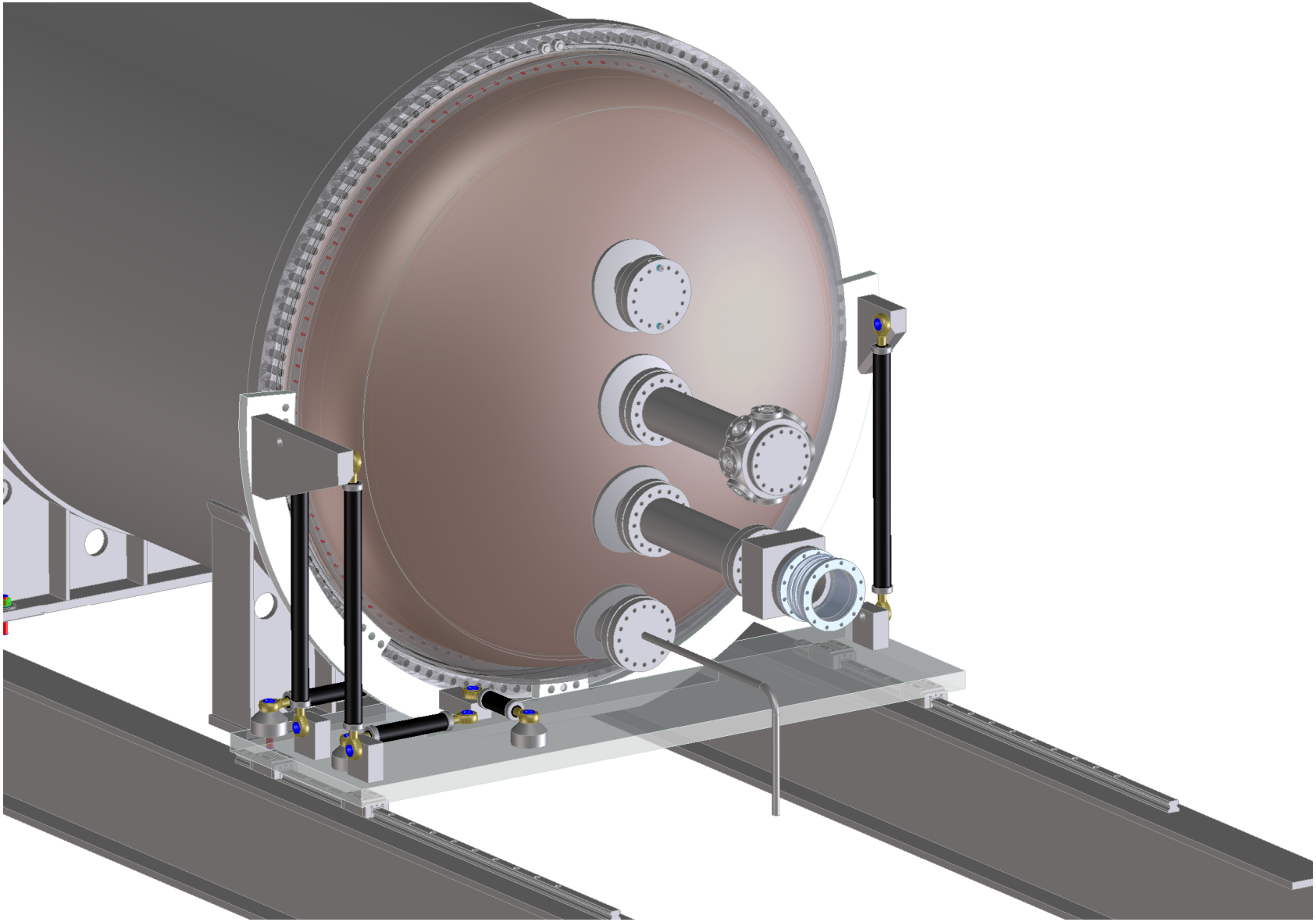

P
Bypass line
P
Vacuum purge
Gas Purifiers
Relief 1500 psi
Flow meter FM
Circulation Pump
P
Argon Gas Supply Cylinder
Xenon Gas Supply Cylinder
P
leak valve, if needed
to Gas Analyzer
Filter
Xenon Reclamation Cylinder
LN2 bath
leak valve, if needed
to Gas Analyzer
capillary
Shielding
capillary
Central Manifold
PMT Enclosures
Dewar
Vac. gauge, for fast valve
VG
Main Pressure Vessel
1.5 cu. m. free vol.
15 bara MOP
16.4bara (15barg) MAWP
Capillary inputs (flanges)
Gas Analyzer multiplexed
Expansion Joint
Solenoid–actuated pilot–operated straight through high flow (25 kg/s) pop–action valve
Solenoid–actuated pilot–operated straight through low flow (5 kg/s) pop–action valve
Vac pump exhaust
pressure relief valve, pilot–operated, pop–action sized for fire, regulator failure
High conductance vac/pressure line
Vacuum Vessel
all purpose
23 cu. m.
1 bara max op. press.
CT
VP
to atmosphere
Vacuum Pump System
Cold Trap
Fast–closing Valve–VAT

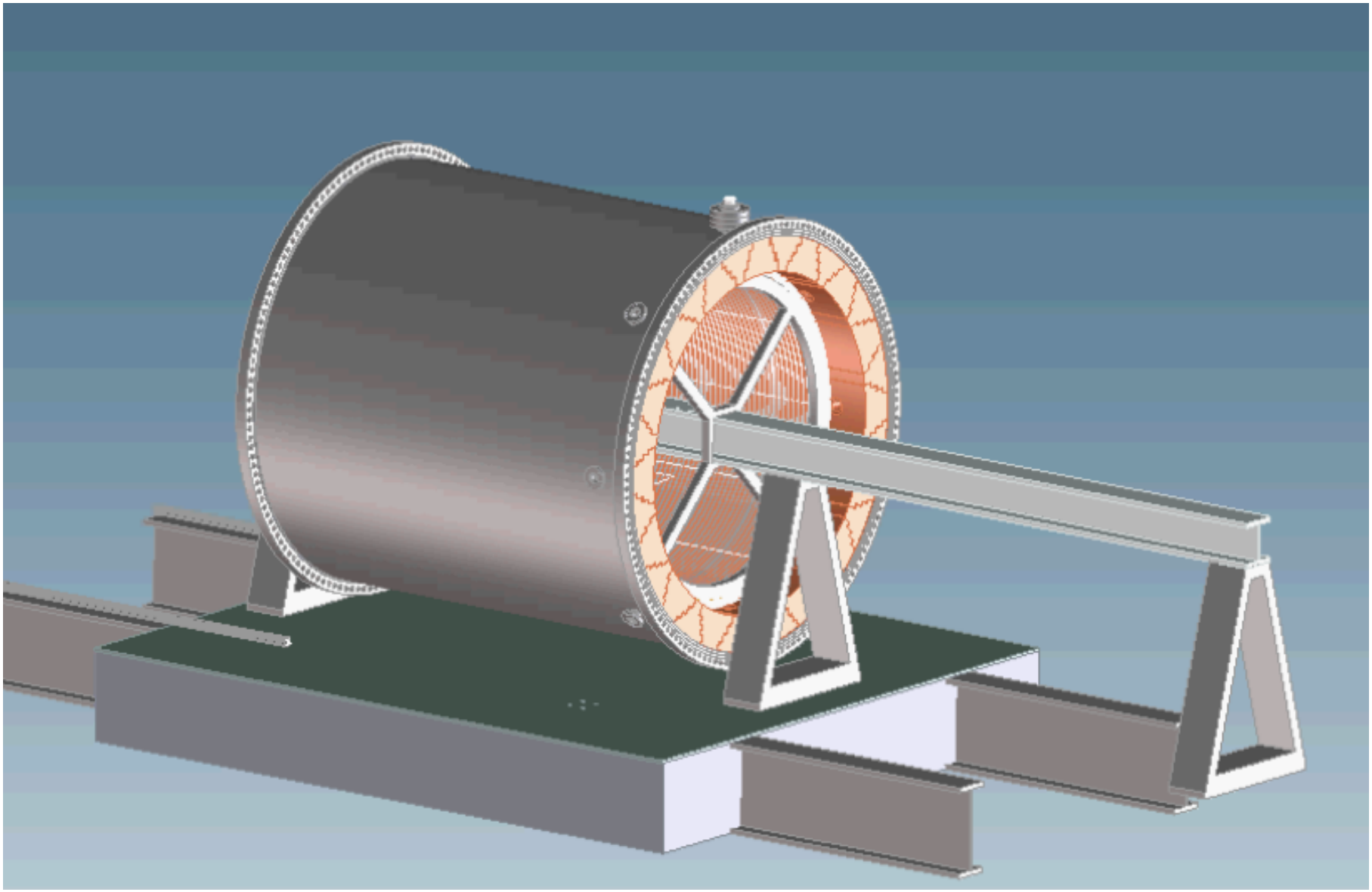
Straight-through fast vent valve (Danfoss) for refrigerants, inert gas



- solenoid actuated for anomalous pressure drop/rise, vacuum loss?
- pilot-operated - pressure on piston backside seals tighter at H.P
- pop-action - poppet opens fully upon action
- concern about permation through gaskets - make our own?

6 strut "hexapod" kinematic support fixture





Reactor Vessels for Food and Pharmaceutical Production

Manifolds for Turnkey Processing Systems

Large Vessel Capability

- Consult with Mfr. on Design
  - Flange, head dimensions achievable with mtl? calcs agree?
  - Get UDS certified
  - check: Helicoflex compatibility, seismic transverse load capacity
  - Review Mfr's construction plan, identify steps of inspection, cleaning, joint prep
  - Can they achieve the specified tolerances? heat treat cycles?
- Proceed with design of remainder of system
  - valve(s) specification
  - recovery vessel (1 or more vessels?, location? bakeable?
  - expansion joint design - what is max pressure? max force on nozzle?
  - start control system specification- what are appropriate fast vent triggers
  - cold trap efficiency? Fast VAT valve appropriate