3rd Wall for Cryogenic Vessel

Activities @ MPI-HD

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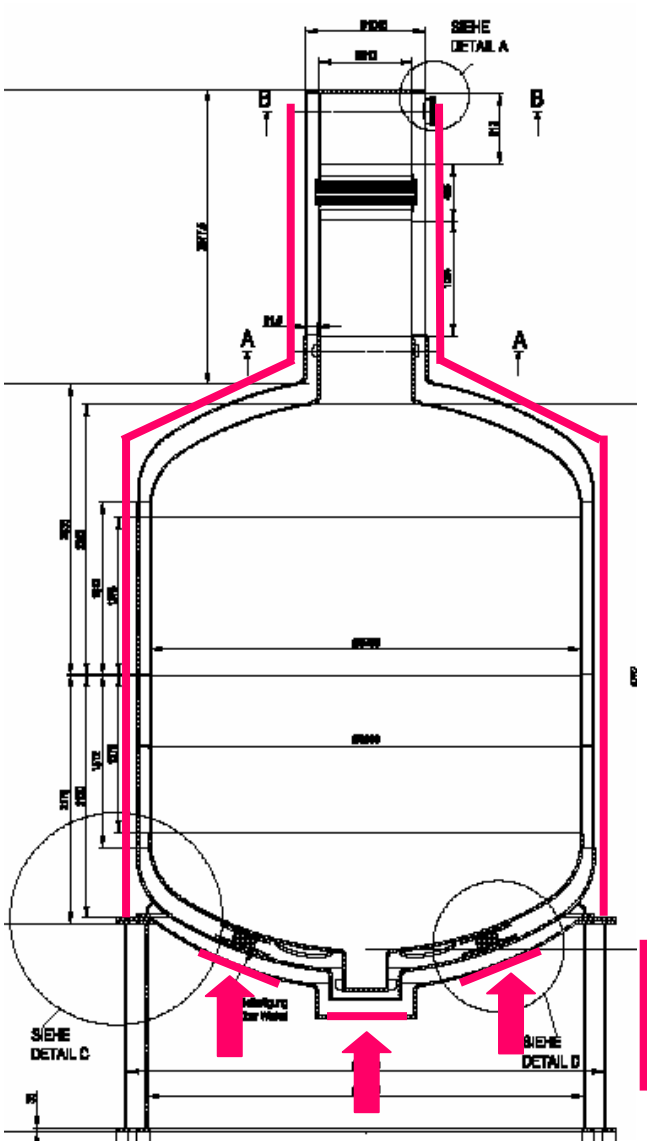
Overview

- Design 1
- Design 2
- Last and Final Design
- Conclusions

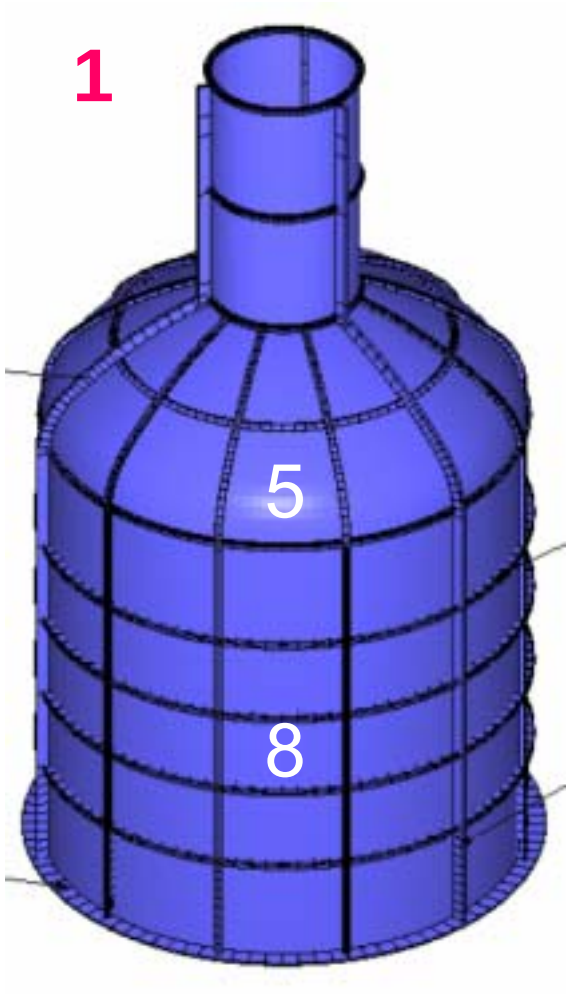
Generic Layout

- follows contour of cryostat
- gap ~ 10 cm
- all copper

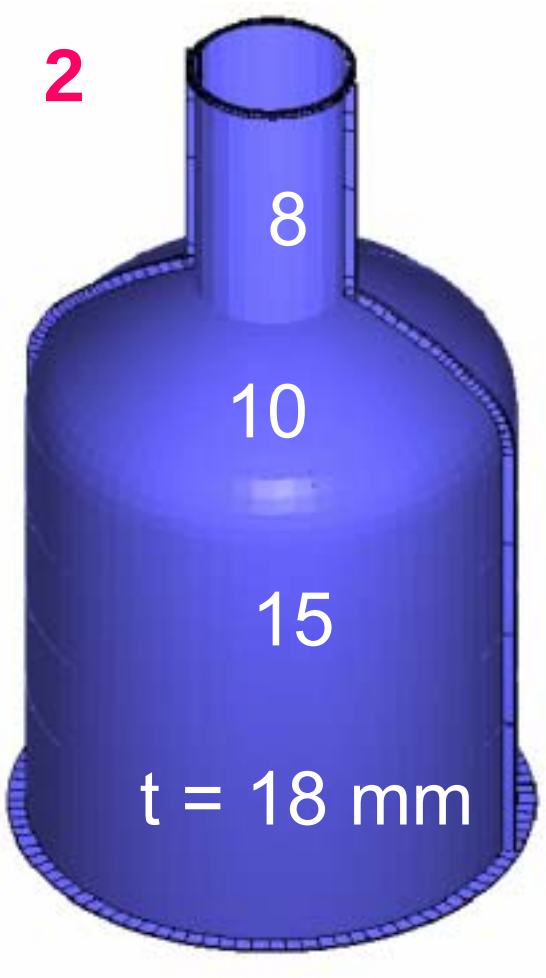


bottom of 3rd wall integrated in skirt

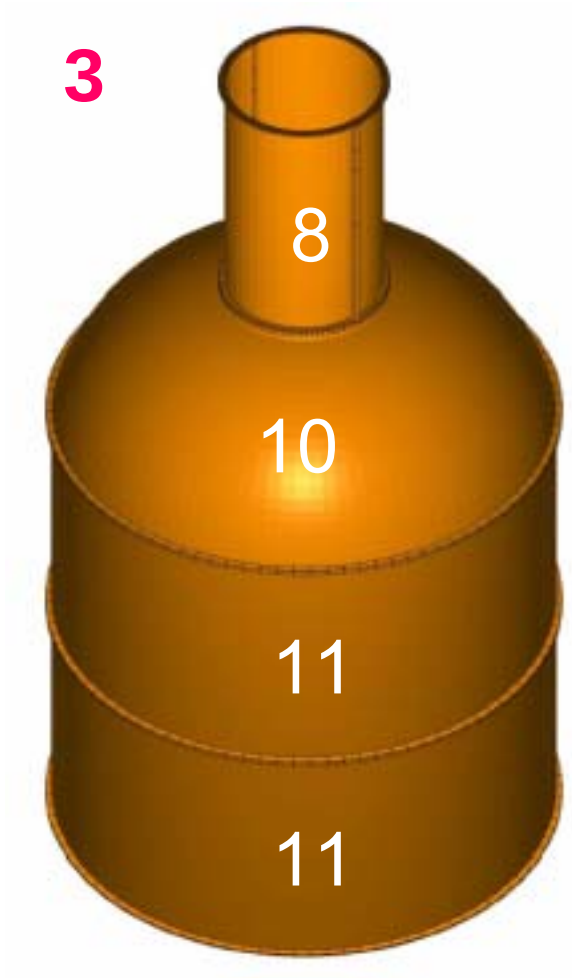
The three 3rd Wall Designs (bottom in skirt)



8t (+ 1.3t struts)



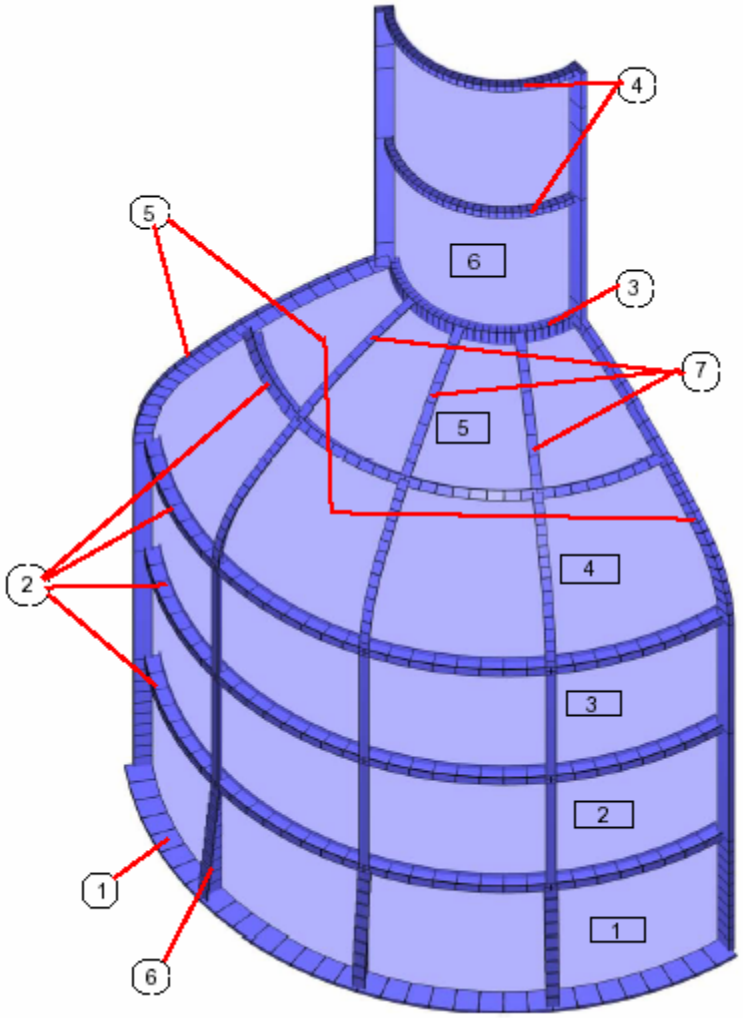
11t



between 8t & 11t

Design 1

PROs / CONs



assembled from 3 segments re-enforced by struts

1 horizontal flange
3 vertical flanges

PROs:

- rigid
- lightweight
- T profiles available & cheap

CONs:

- EB welding of profiles to shell prohibitively difficult / expensive.
- surface difficult to clean, has many edges
- crossing seals

abandoned

Design 2

PROs / CONs

assembled from 2 (3) segments consisting of solid metal sheets,
1 horizontal flange
2 (3) vertical flanges

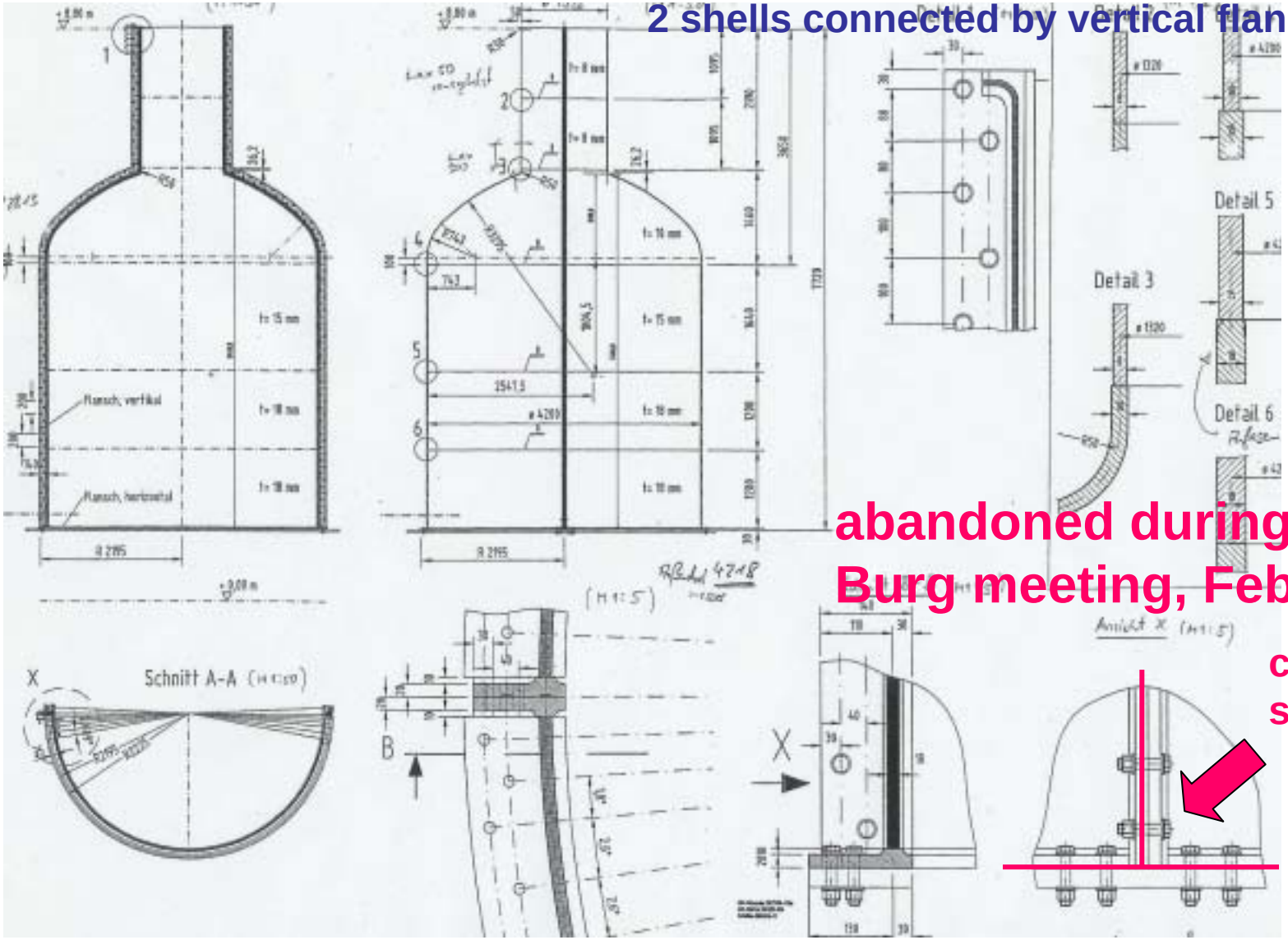
PROs:

- smooth surfaces
- no T profiles needed

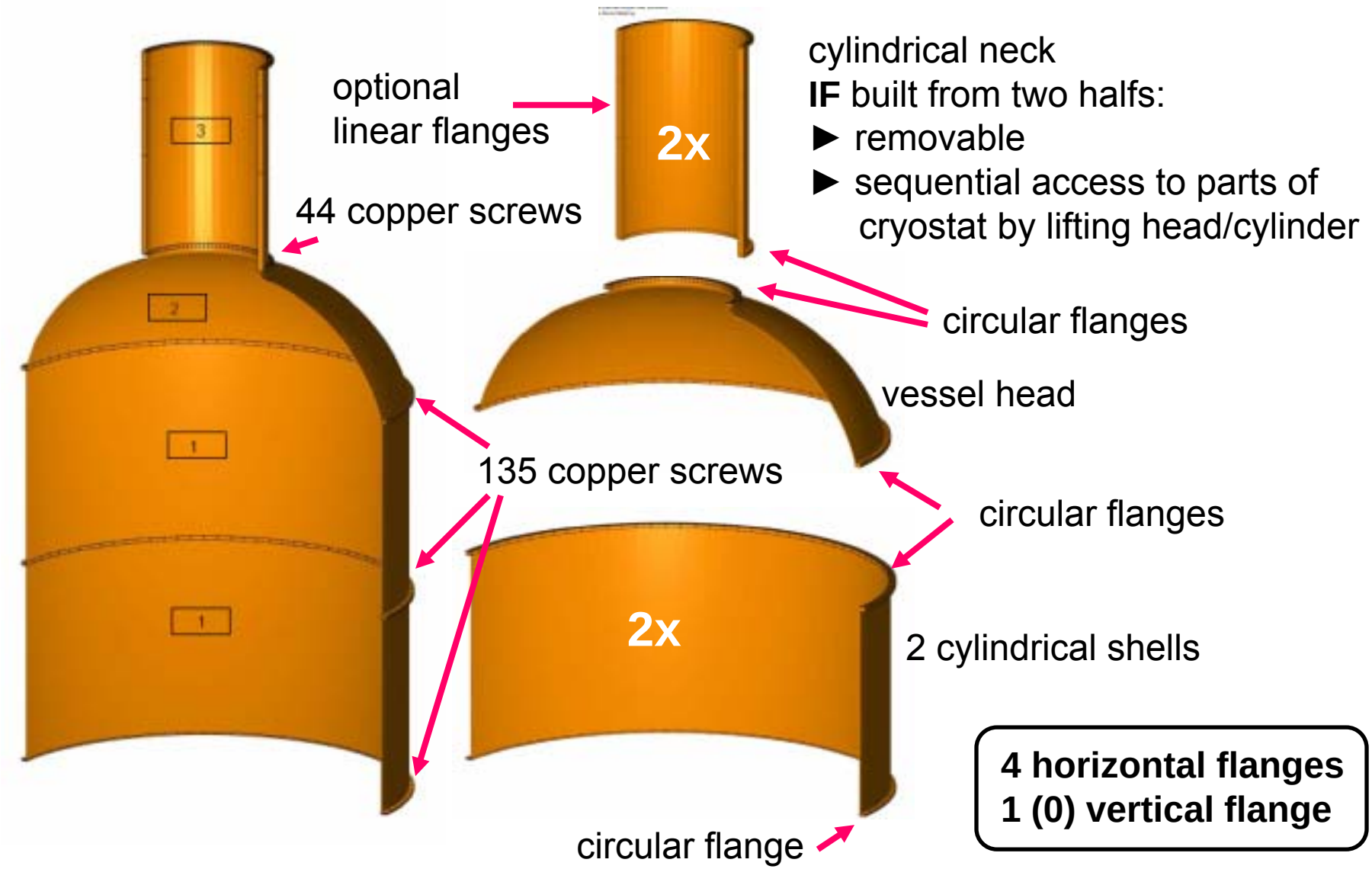
CONs:

- fixation & welding of curved 7m long flanges difficult
- vessel head might loose shape when cut into halfs
- shell might be easily torn
- crossing seals

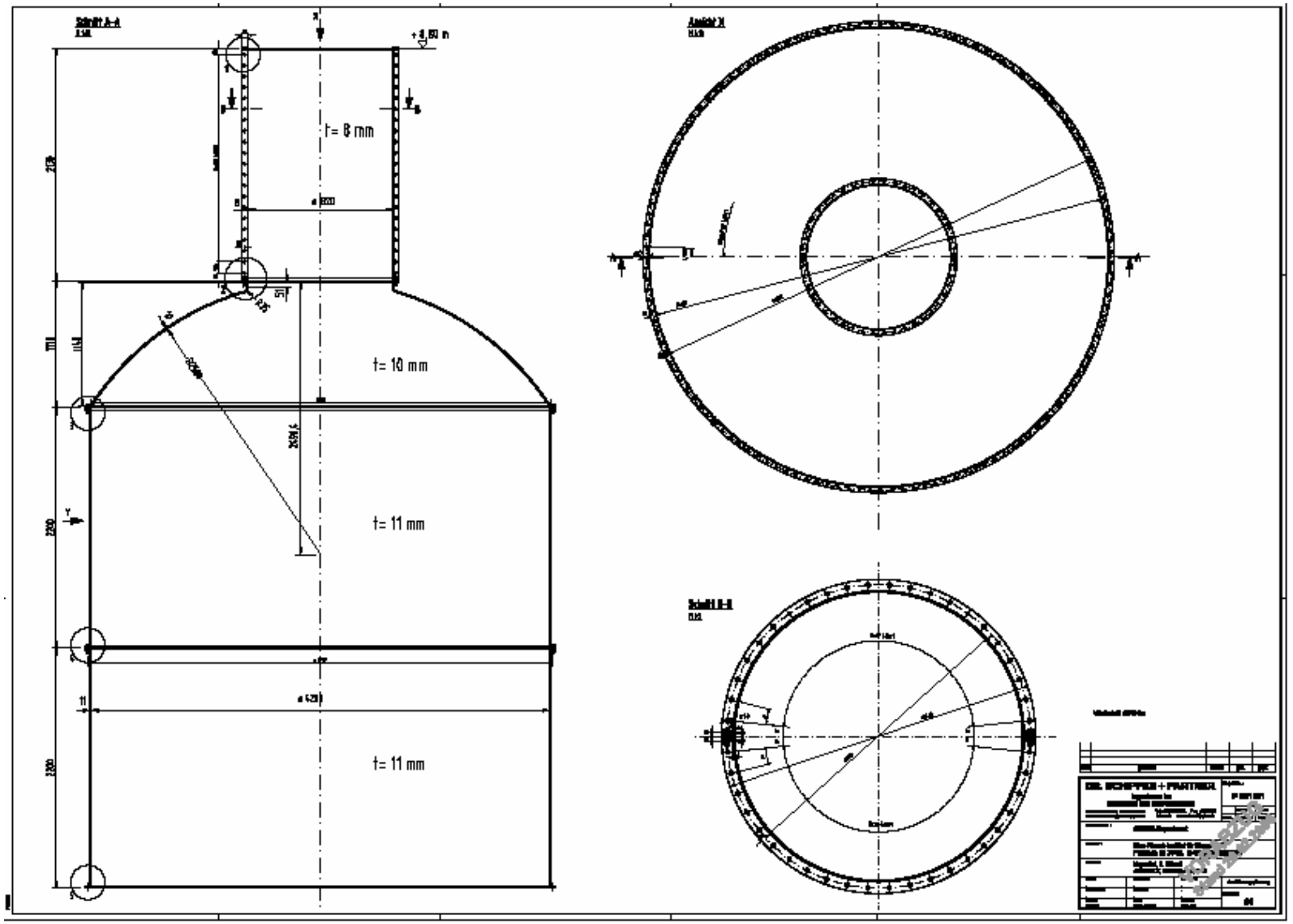
Design 2 Prelim. Production Drawing



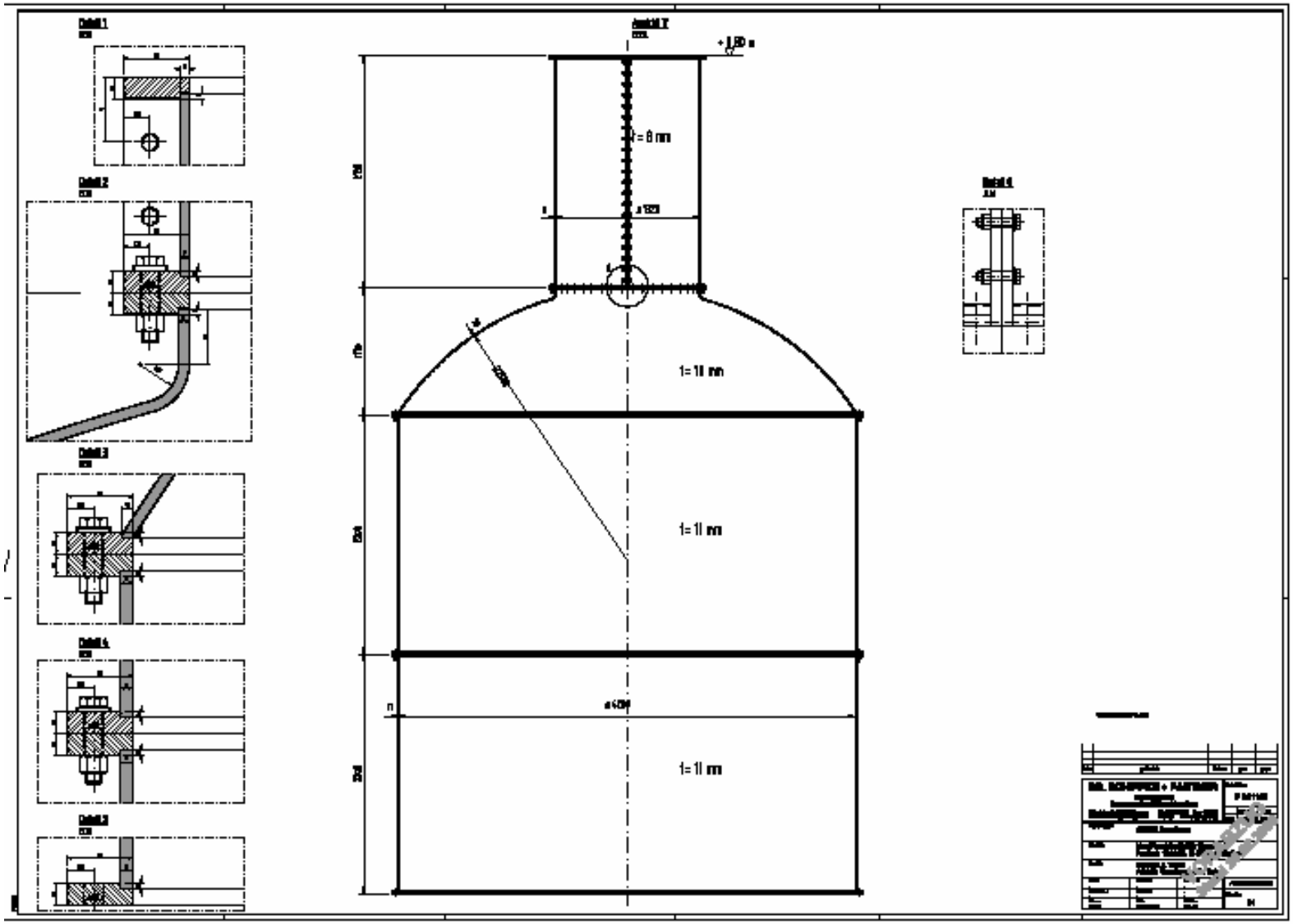
Design 3


optional
linear flanges
2x
cylindrical neck
IF built from two halfs:
► removable
► sequential access to parts of cryostat by lifting head/cylinder
44 copper screws
circular flanges
vessel head
135 copper screws
circular flanges
2x
2 cylindrical shells
4 horizontal flanges
1 (0) vertical flange
circular flange

Design 3 — 1st DRAFT: Production Drawing



Design 3 — 1st DRAFT: Production Drawing



GORE-TEX® Joint Sealant

Teflon

Key Features

- 100 percent expanded PTFE
- Chemically inert, temperature resistant
- Ideal for large, complex, and damaged surfaces
- No wasteful scrap
- Resistant to creep and cold flow

Key Benefits

will be used also as cryostat-manifold seal

- Outstanding versatility
- Easy to install
- Low stress-to-seal
- Reliable sealing performance
- Lowers total sealing system cost

Technical Data

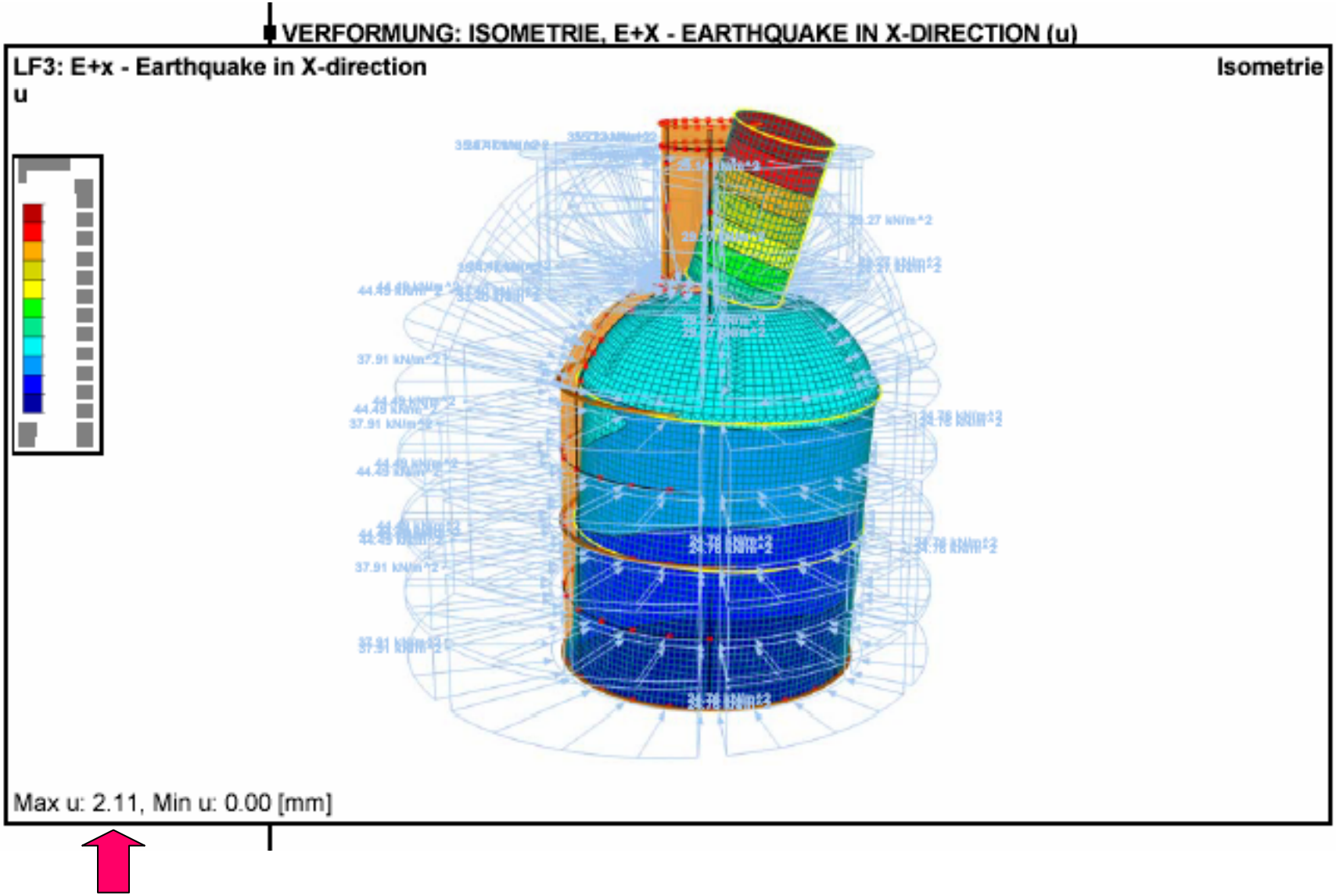
Material: 100% expanded PTFE
Temperature range: -450°F to 600°F (-268°C to 315°C)
Operating pressure: Vacuum to 3,000 psig (200 bar)
Chemical resistance: Resistant to all common chemicals in 0-14 ph range except molten alkali metals and elemental fluorine

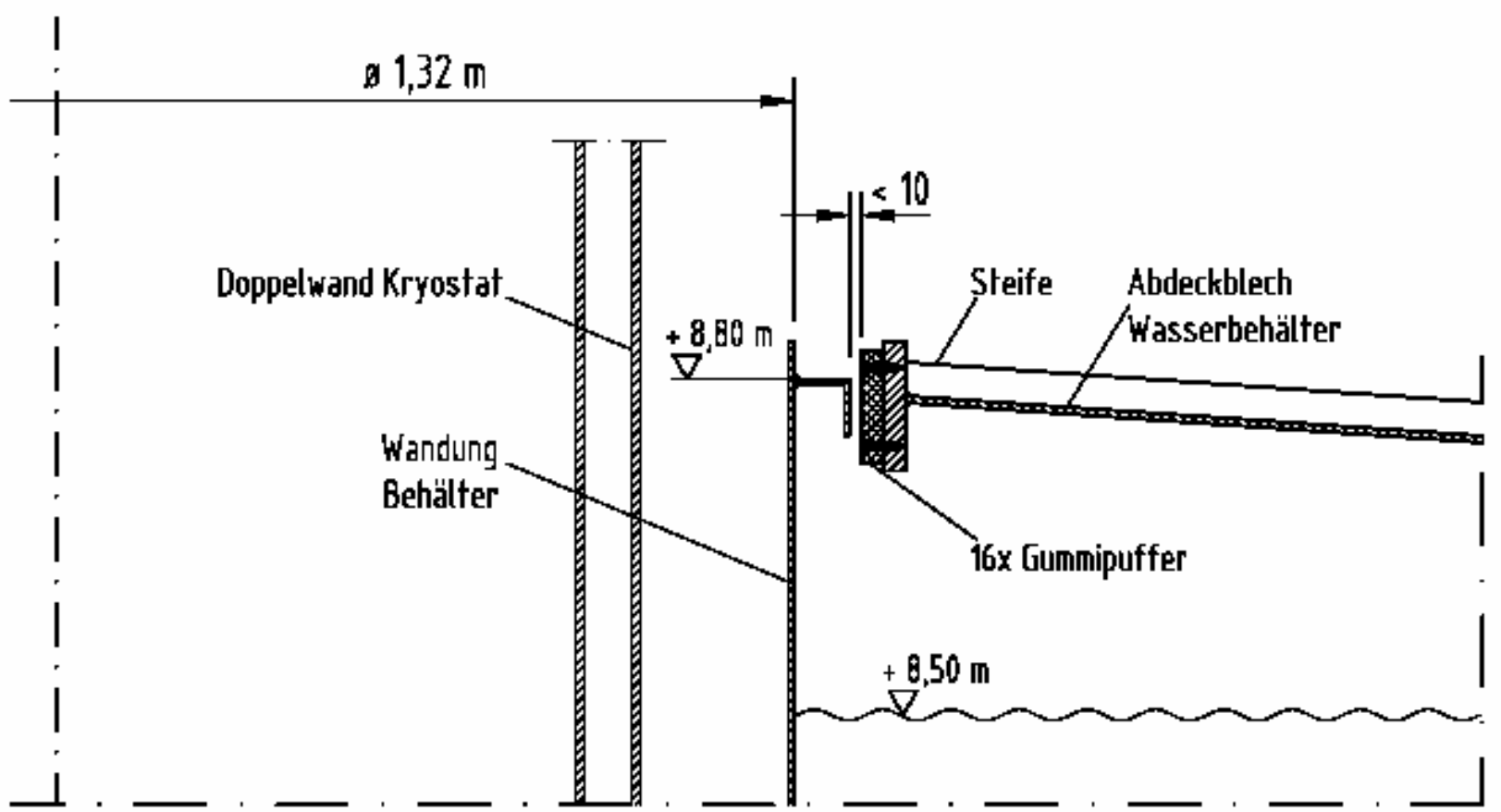
GORE-TEX® Flachdichtung DF

Technische Informationen

Werkstoff:	100% virginales ePTFE mit monodirektional orientierter Fibrillenstruktur. Der Werkstoff ist asbestfrei und frei von anderen lungengängigen Stoffen.
Temperaturbeständigkeit des Werkstoffes:	-240°C bis +270°C, kurzzeitig bis +315°C
Chemikalienbeständigkeit:	Beständig gegen alle Medien pH 0-14, ausgenommen gelöste oder geschmolzene Alkalimetalle, sowie elementares Fluor bei höheren Temperaturen und Drücken.
Physiologische Unbedenklichkeit:	Im Dauertemperatureinsatz bis +260°C physiologisch unbedenklich nach VDE/VDI 2480, die Anforderungen nach FDA werden erfüllt.
Druckbeständigkeit:	Bis 250 bar je nach Betriebsparametern und Einbauverhältnissen
Vakuumbeständigkeit:	Helium Leckrate $3*10^{-8}$ mbar * 1 * s^{-1} bei /\p = 1 bar
Alterungsbeständigkeit:	GORE-TEX® Flachdichtungen DF unterliegen im zulässigen Einsatzbereich keiner Alterung.
Zulassungen / Prüfungen:	- TÜV Prüf.-Nr MP2/8933-1-85 ermittelte

Design 3 FEM Simulation of Earthquake Effects




ø 1,32 m
< 10
Doppelwand Kryostat
+ 8,80 m
Steife
Abdeckblech
Wasserbehälter
Wandung
Behälter
16x Gummipuffer
+ 8,50 m

Concluding Remarks

- The aim was to find an economic solution for a dismountable 3rd wall following the contour of the cryostat. ► Not reached!

► Present solution follows indeed the cryostat's contour, can be built - but is neither demountable nor cheap.

Can be installed / removed only before the water tank installation.

After installation:
bottom part of cryostat no longer accessible;
other parts (in principle) accessible after removal of neck;
vessel head and cylinders no longer removable w/o destruction.

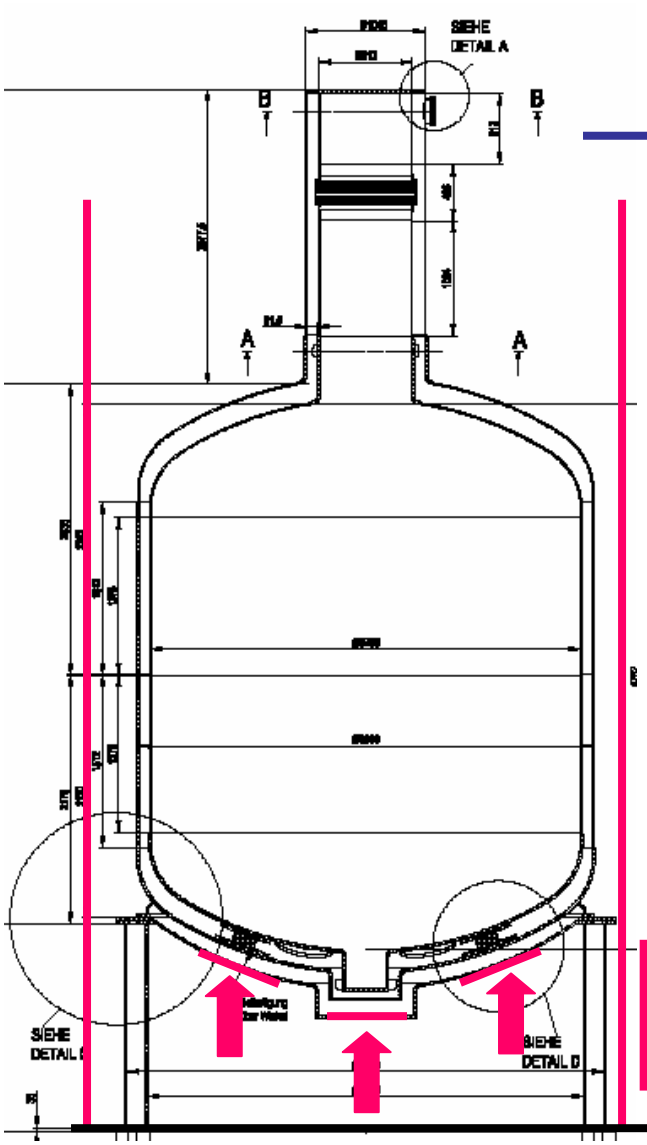
- Are there still attractive / realistic alternatives?

yes ?

▼

Configuration with water between cryostat & 3rd wall, small water volume►fast drain: originally proposed by 2nd opinion consultant due to superior performance in case of earthquake: better damping, less load due to buoyancy; furthermore easy access to cryostat for inspection(!), and removable. Not so much cheaper.

Alternative Layout ?



water level

bottom of 3rd wall
no longer needed