Vacuum options for decay volume

NRC KI, NUST MISiS, NIKIET

Alexander Malinin, NRC KI

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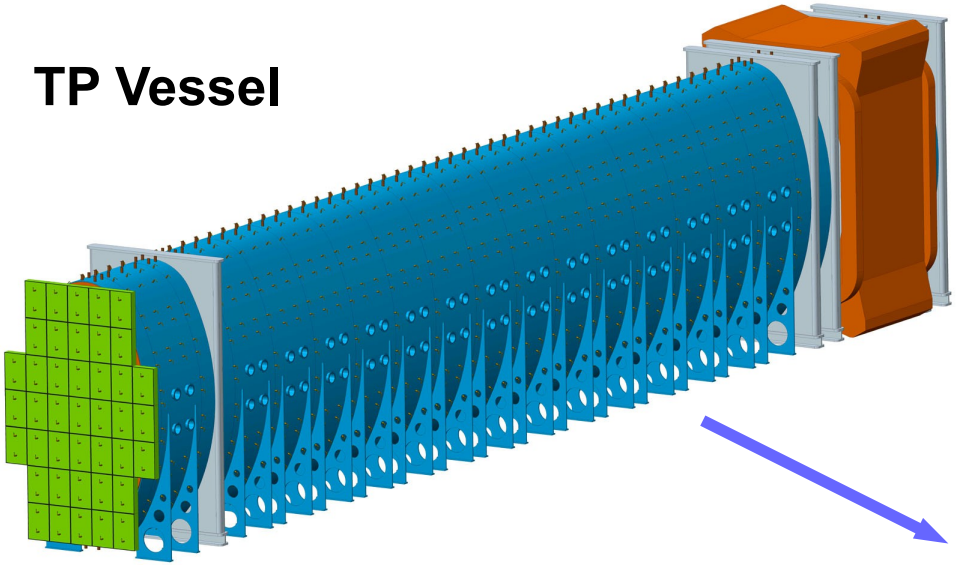
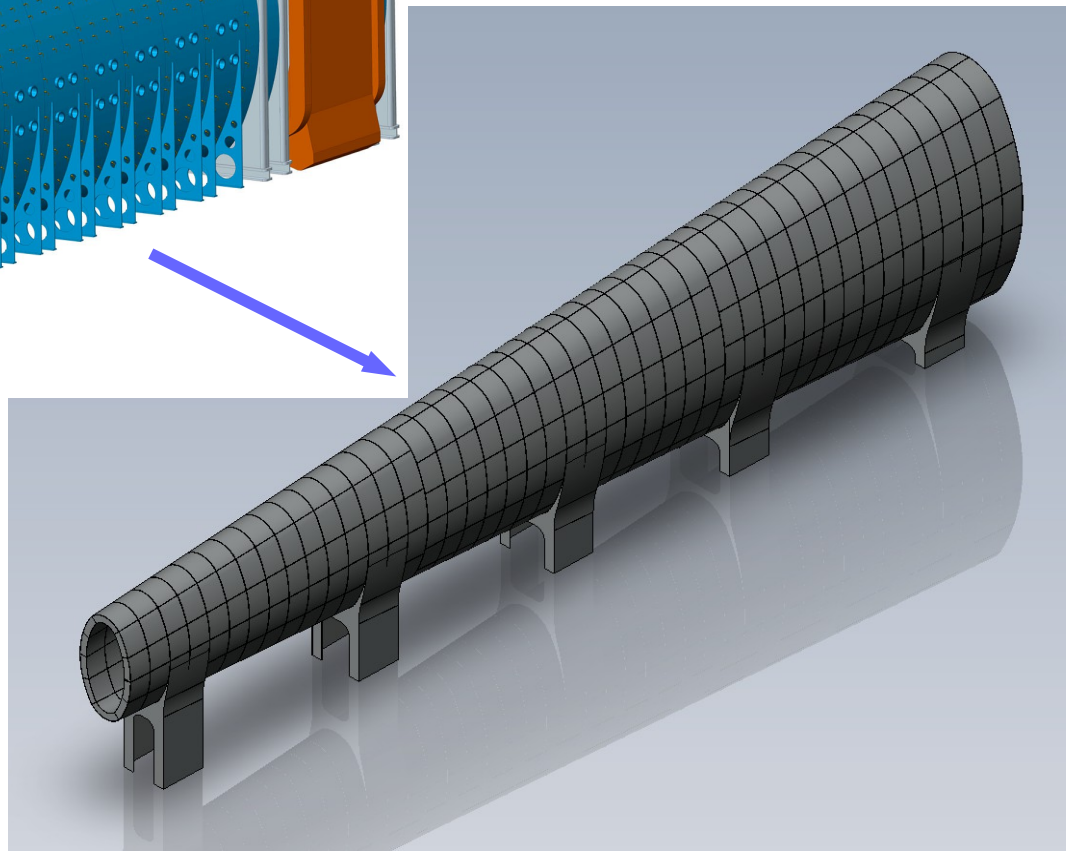
Conical Vacuum Vessel option

TP Vessel



Change to conical Vessel to increase the acceptance

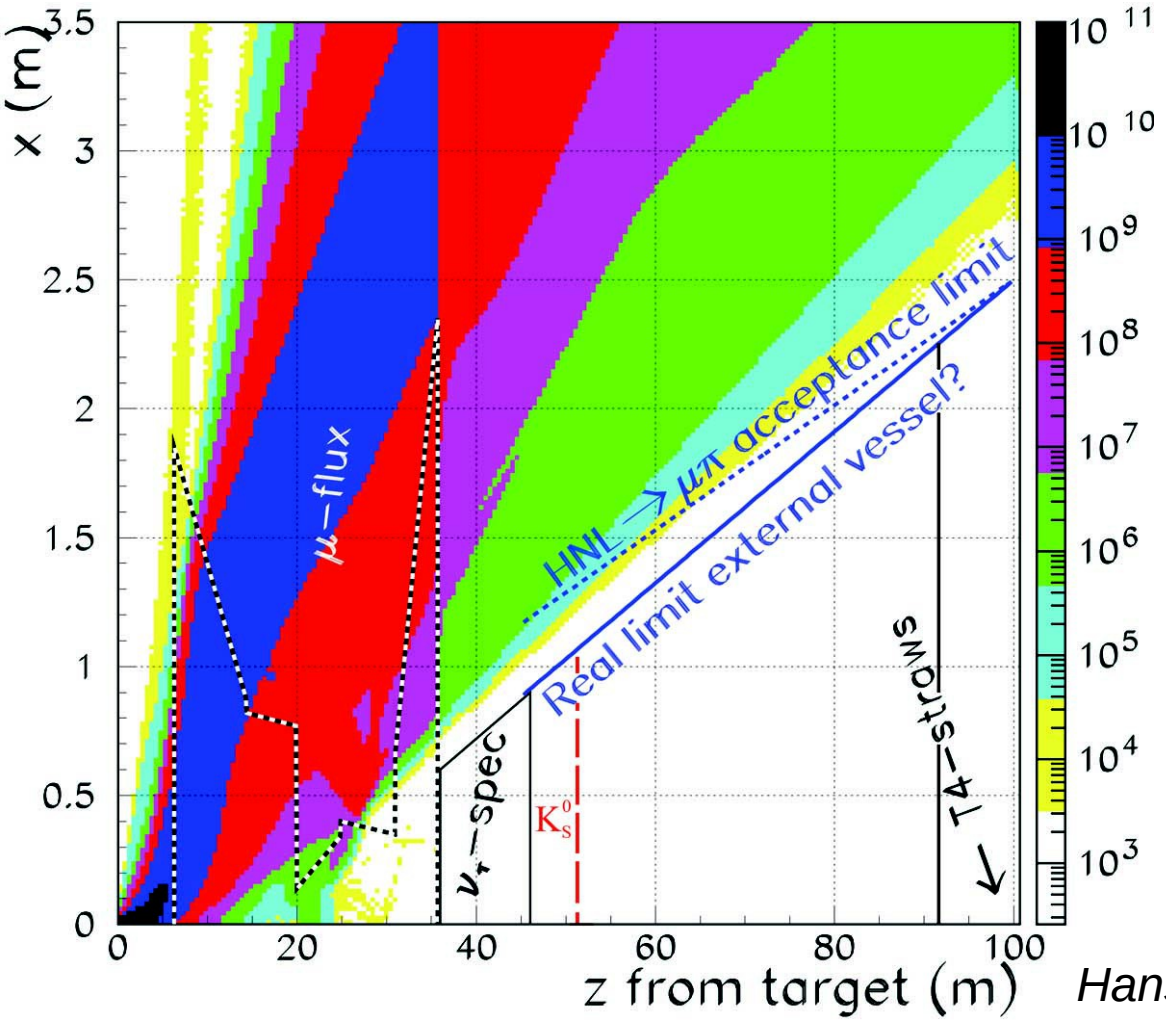


New Vessel dimensions:

front ellipse axis: 2 m, 4 m,
rear ellipse axis: 5 m 10 m,

Total length: 45 m (with 5m V^0 veto chamber).

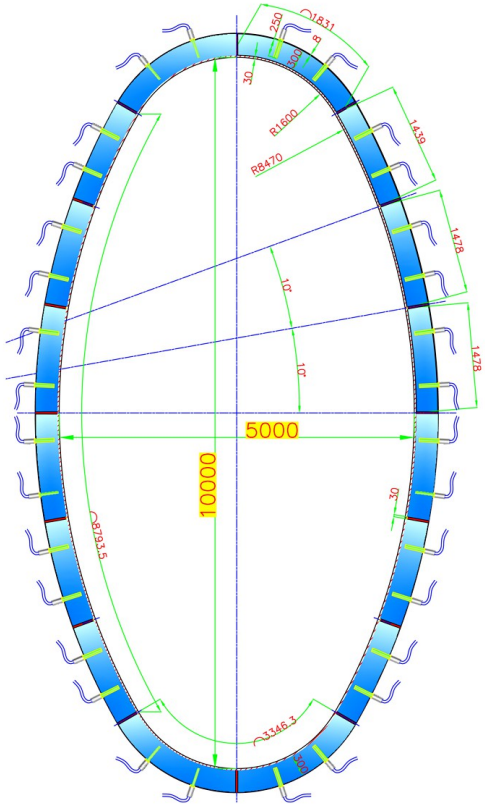
Conical Vacuum Vessel envelope

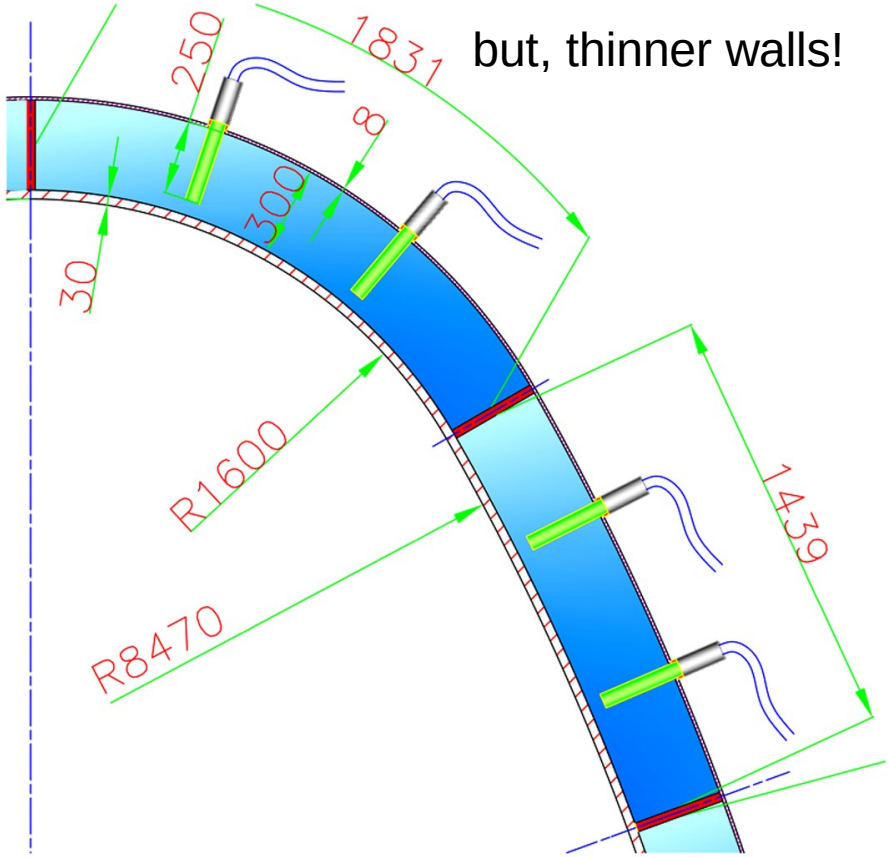


Hans Dijkstra

Steel Vacuum Vessel's structure

LS cells are similar to the TP VV:

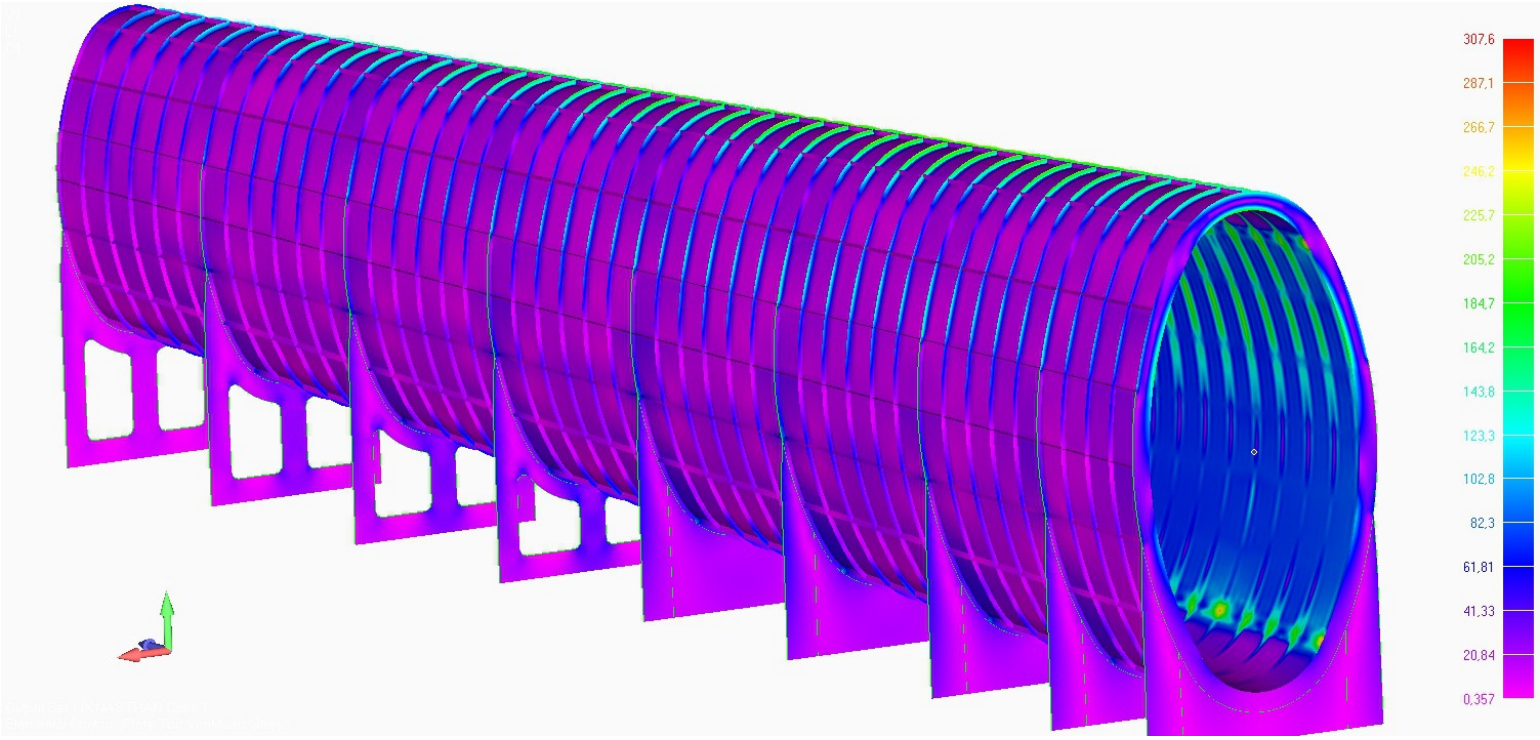




but, thinner walls!

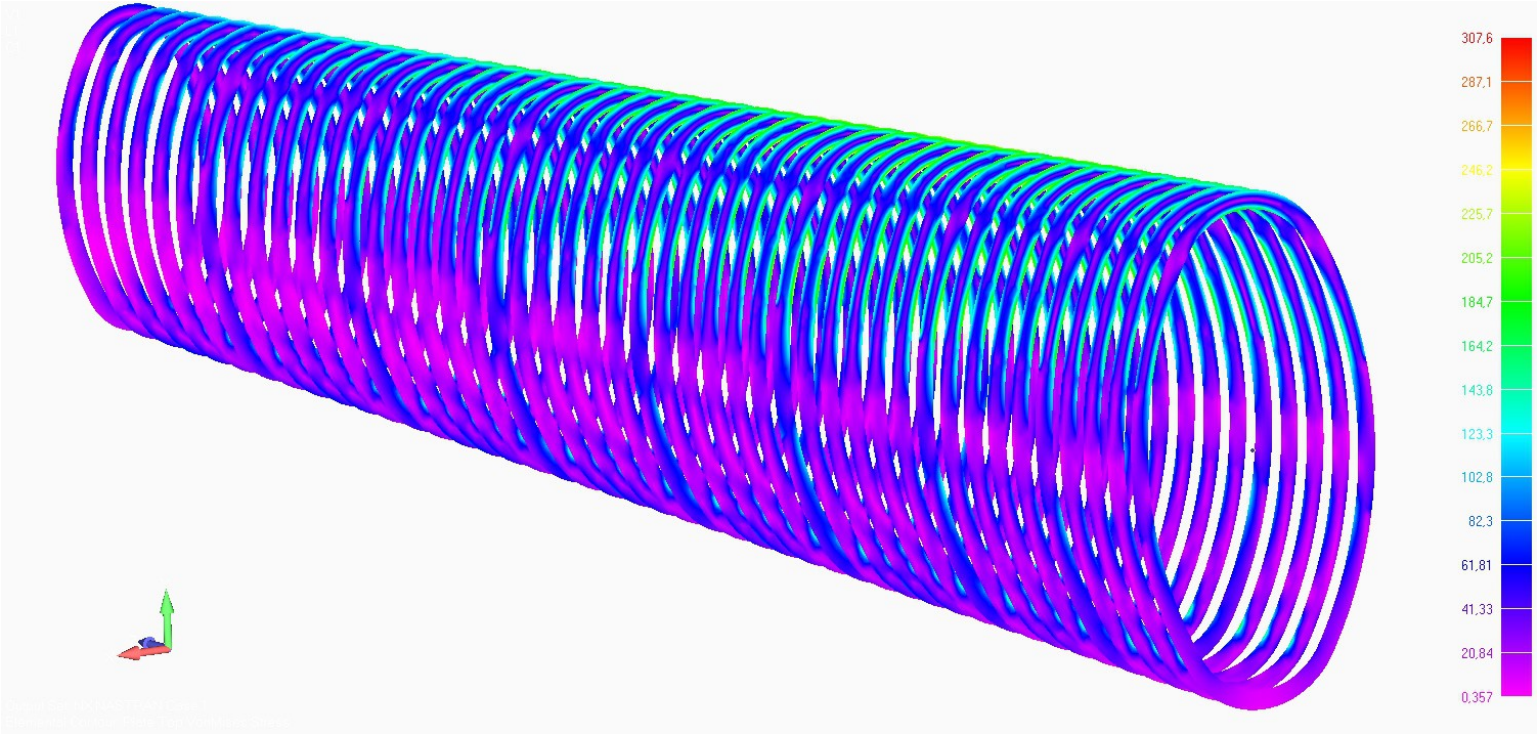
Steel Vacuum Vessel's model

New FE simulation using Nastran и Solidworks



Steel Vacuum Vessel's model

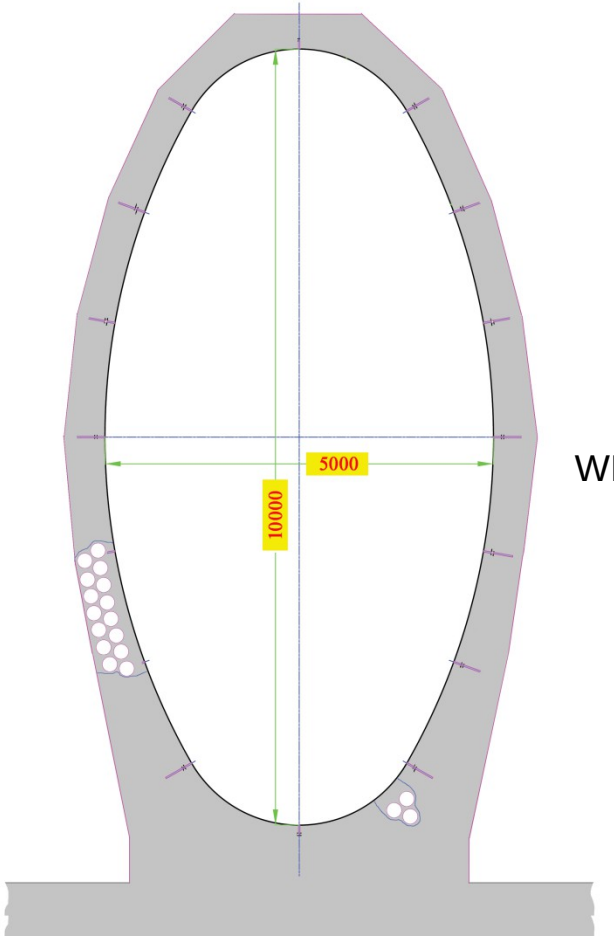
Transverse ribs stresses

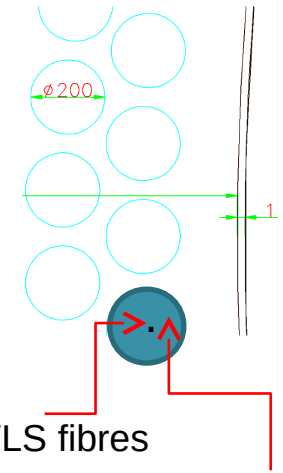


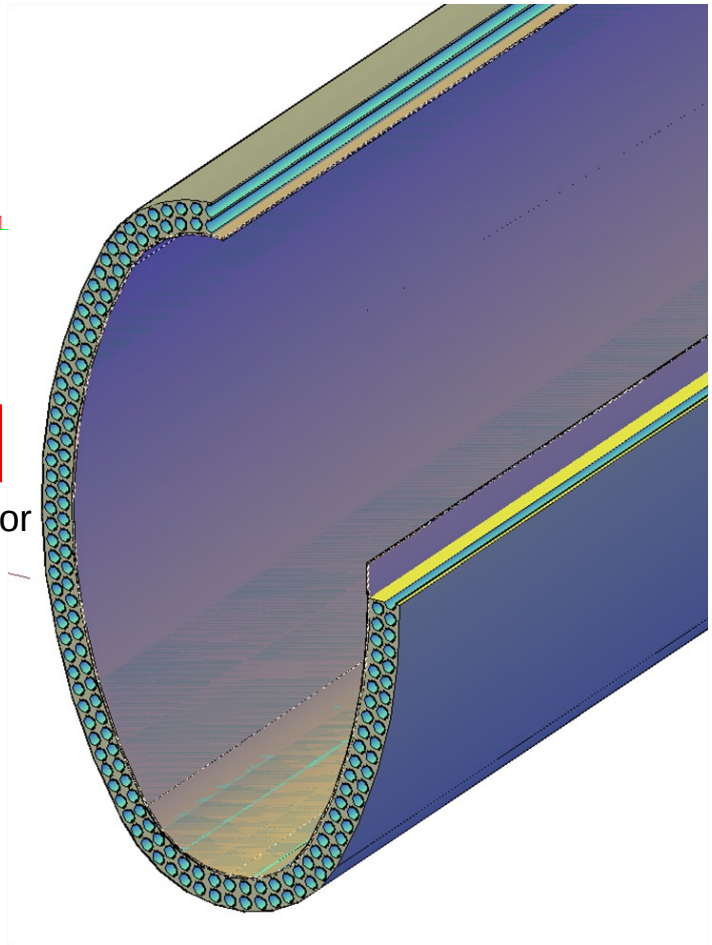
Steel Vacuum Vessel's model

- The maximum tension (static) in the inner shell was at the area of its attachment (welds) to the transverse ribs - about 244 MPa.
- In the center of the sheet the tension is about 72 MPa.
- The outer shell experiences less stress - from 43 to 5 MPa.
- However, its thickness has to be determined, primarily, from the conditions of mechanical rigidity (stability), and not the strength.

Concrete Vacuum Vessel (conical)







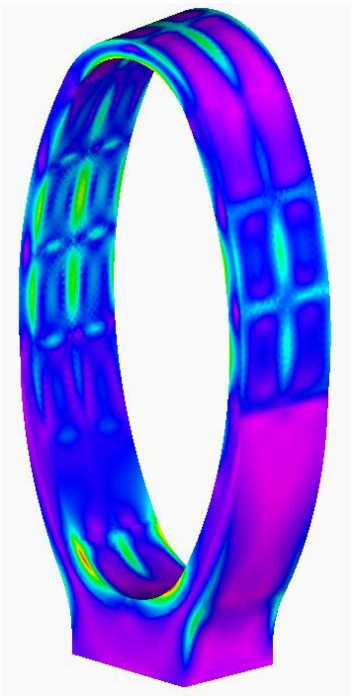
Concrete Vessel model

VV finite-element modeling:

High density concrete walls, basalt fibre armature bars (~ 0.1 $/m) Vacuum Vessel.

8 mm aluminum welded inner skin, anchored in the armature structure.

Inner dimensions are the same, as for the new conical steel Vacuum Vessel.



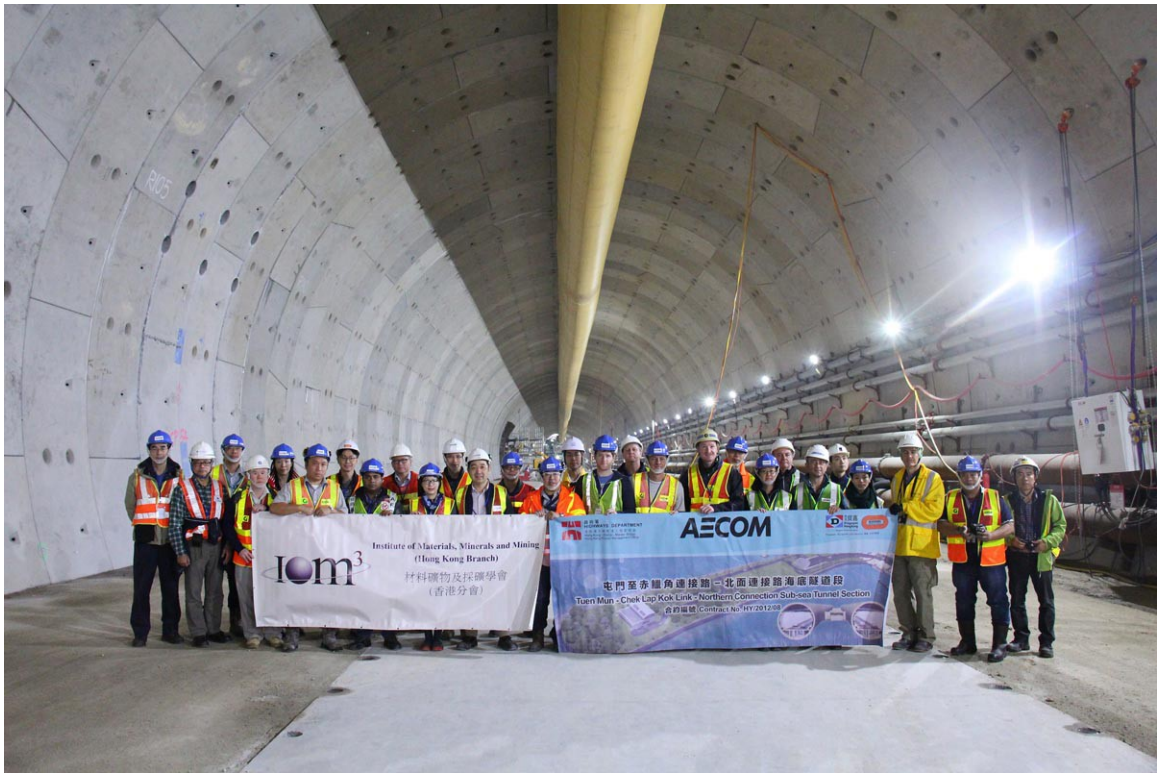
To house Liquid Scintillator Background Event Tagger, a double layer of LS-filled pipes is incorporated in the concrete for full VV length.

Concrete bunker option?

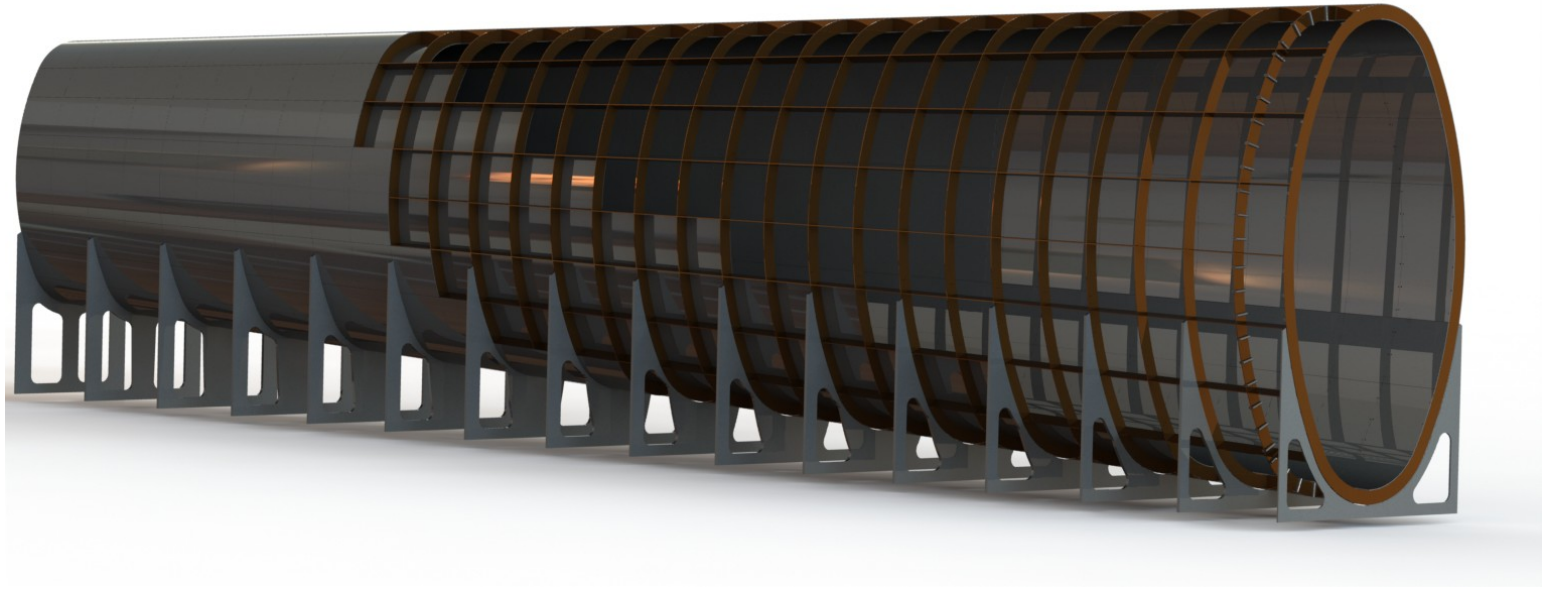
NASA has built the world's largest (11,300 m^3) vacuum chamber at its Glenn Research Center. It was used since 1965 to conduct thermal vacuum testing of the Apollo Command Module.

Concrete bunker option?

The world's largest diameter (17.5 m) long tunnel:



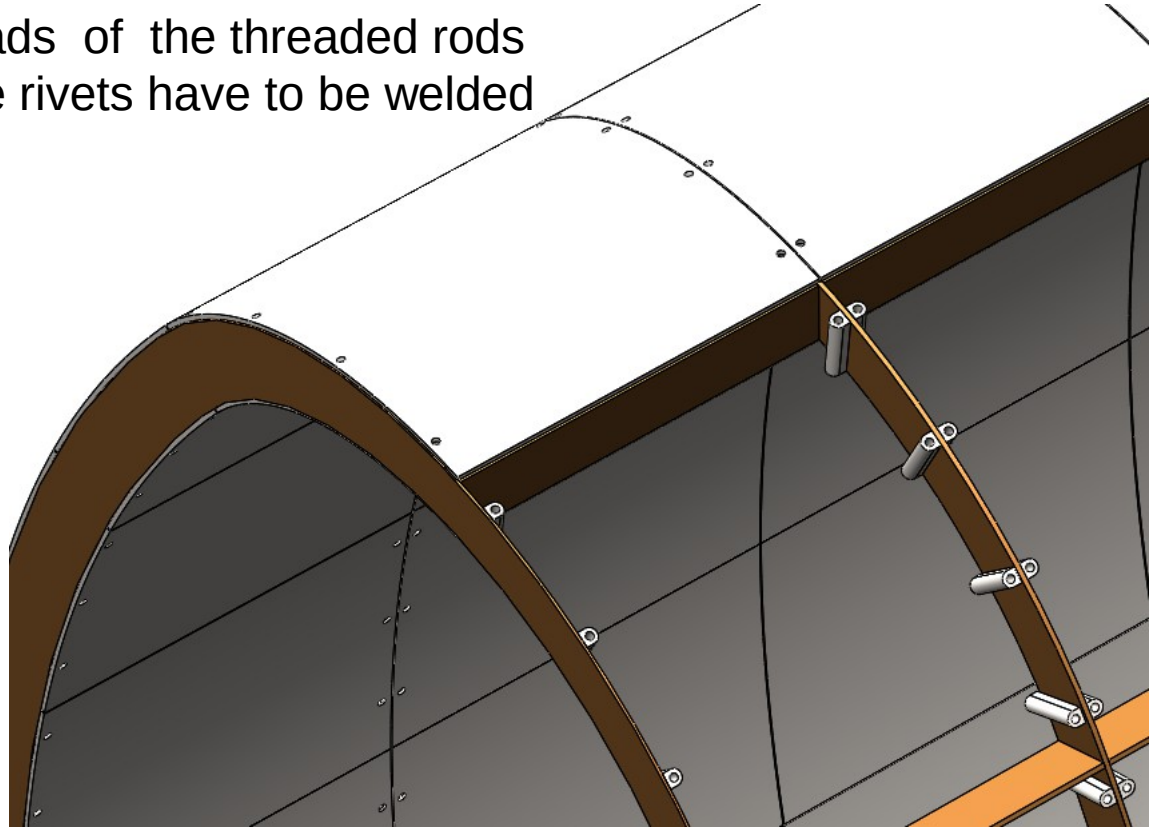
Conical LS SBT model



Conical LS SBT model

Attachment brackets are shown:

The heads of the threaded rods or of the rivets have to be welded around.



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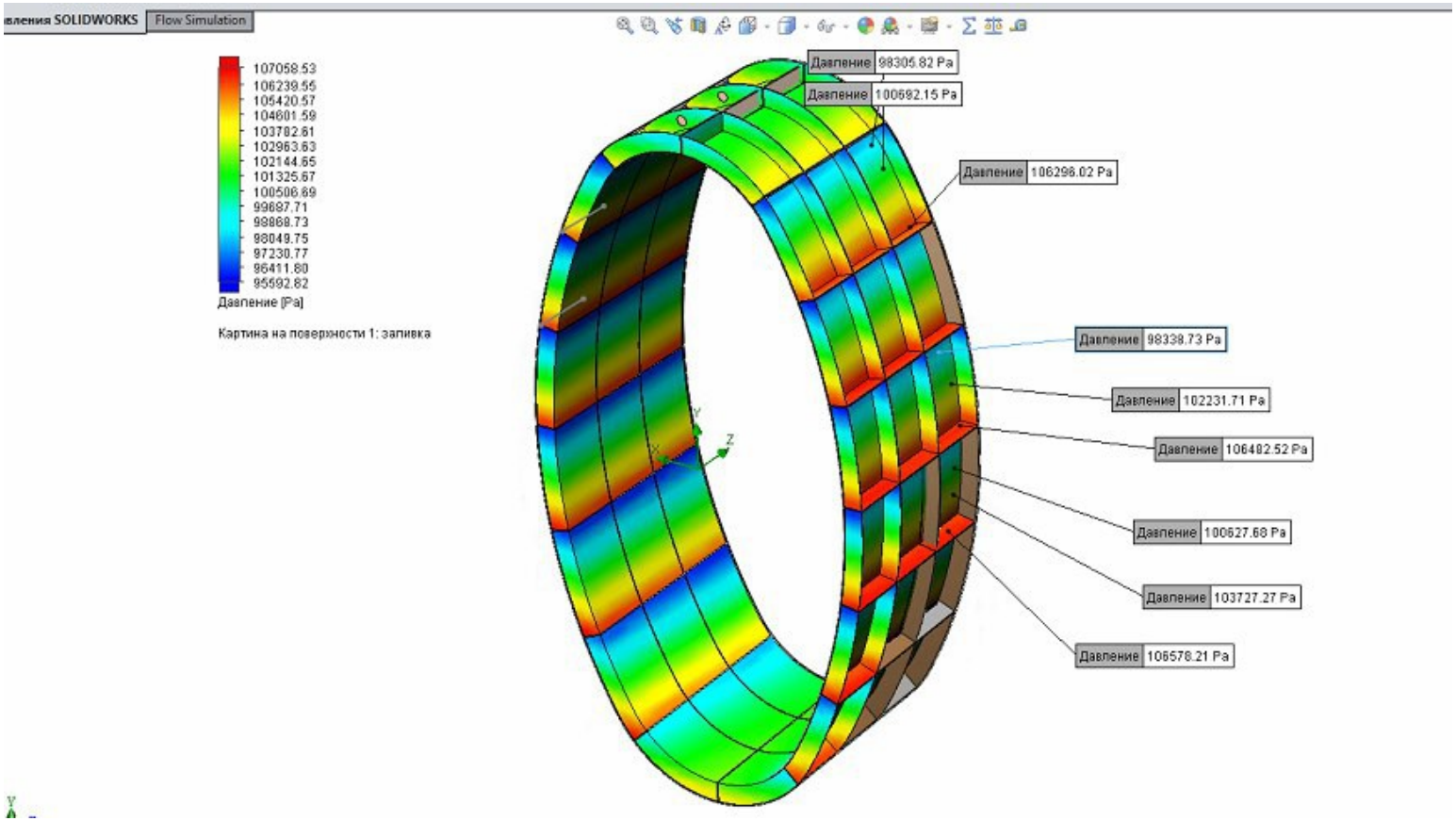

Vessel's structural parameters

VV case	LS volume	Metal volume	Metal mass	Thickness Outer shell	Thickness Inner shell	Thickness Ribs	Safety factor
Aluminum alloy normal pressure	227 м^3	18,5 м^3	49 т	5 mm	5 mm	12 mm	1,2
Steel normal pressure	227 м^3	17,08 м^3	133 т	4 mm	4 mm	8 mm	1.8
Steel vacuum	227 м^3	27.43 м^3	214 т	8 mm	10 mm	14 mm	2.1

For TP Vacuum Vessel was: Metal volume 68.5 m^3 , LS volume 367 m^3

Conclusions

- The conical Vacuum Vessel is more stable and requires less material to satisfy the static stability requirements.
- Concrete conical vessel's FE modeling has started. More news later.
- Thin walled stainless steel or aluminum structure to contain the LS was studied. It is compatible with both the He and concrete bunker options. It is light, but stresses under control.
- First iteration structural parameters for 3 Decay Vessel options were determined.