Vacuum options for decay volume

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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° veto chamber).

Vacuum Vessel Options

8th SHiP Meeting
Conical Vacuum Vessel envelope

Vacuum Vessel Options 8th SHiP Meeting

Hans Dijkstra
Steel Vacuum Vessel’s structure

LS cells are similar to the TP VV: but, thinner walls!

Vacuum Vessel Options

8th SHiP Meeting
Steel Vacuum Vessel’s model

New FE simulation using Nastran и Solidworks
Steel Vacuum Vessel’s model

Transverse ribs stresses
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)

Vacuum Vessel Options

8th SHiP Meeting

Liquid scintillator

WLS fibres
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 m³) 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.
Conical LS SBT model
### Vessel's structural parameters

<table>
<thead>
<tr>
<th>VV case</th>
<th>LS volume</th>
<th>Metal volume</th>
<th>Metal mass</th>
<th>Thickness Outer shell</th>
<th>Thickness Inner shell</th>
<th>Thickness Ribs</th>
<th>Safety factor</th>
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</thead>
<tbody>
<tr>
<td>Aluminum alloy</td>
<td>227 м³</td>
<td>18,5 м³</td>
<td>49 т</td>
<td>5 мм</td>
<td>5 мм</td>
<td>12 мм</td>
<td>1,2</td>
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<tr>
<td>Steel</td>
<td>227 м³</td>
<td>17,08 м³</td>
<td>133 т</td>
<td>4 мм</td>
<td>4 мм</td>
<td>8 мм</td>
<td>1,8</td>
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<tr>
<td>Steel</td>
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<td>27.43 м³</td>
<td>214 т</td>
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</tbody>
</table>

For TP Vacuum Vessel was: Metal volume 68.5 м³, LS volume 367 m³
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.