Scenarios of replacing existing storage tank bottoms

Hans Svensgaard
BD & Marketing
3 scenarios of replacing existing tanks bottoms:

- Replacement of bottom and establishing a new foundation
- Replacement of bottom and realigning of existing foundation
- Establishing a new double-bottom using the “envelope”-method
- Compare the 3 methods, pros and cons
Our new name
Storage tank construction
Turnkey projects

Our storage tanks services:

New tanks
• Engineering and consulting
• Construction
• Size up to 100,000 m3
• Design according to EN14015, API650, NFPA11 & 15

Refurbishment
• Maintenance and repair
• Modification and reconstruction
• According to API653, EMMUA159, NFPA11 & 15

We provide turnkey projects acting as EPC contractor
Method 1
Replace bottom and new foundation

Remove old annular plates and bottom:

- Annular/bottom is realised from shell by cutting or gouging
- Complete tank is lifted, allowing annular and bottom plates to be removed.

- As example 800 mm lifting height of tank.
- The tank lifters must be located on the outside of the tank and with a distance to the shell making sufficient space for the new foundation to be made.

- A calculation is needed for the special brackets.
- New foundation is prepared
Method 1
Replace bottom and new foundation

New annular:
- The new annular plates are installed and welded.
- The tank is lowered on to the new annular ring.

New bottom:
- Sump is installed.
- Bottom plates are installed. Overlap min 5 times plate thickness plus 5 mm for welding shrinkage. A 9 mm bottom must have 5x9+5=50 mm overlap.
- Welding of the tank bottom plates must follow a specific sequence, to avoid bulges.
- Last welding is annular to bottom.
Method 1
Replace bottom and new foundation

Welding of annular plate to shell:

• Intermediate supports are installed between shell and annular plates, to keep the correct angle
• The first welding is from the outside
• The supports are remove by grinding.
• The location of the supports are grinded and inspected.
Method 2
Replace bottom and realign exist. foundation

Remove old annular plates:
• Complete tank is lifted if all annular plates are to be replaced. With smaller tanks a crane can lift and remove the complete tank.
• If only some annular plates are to be replaced, tank can be partly lifted, using hydraulic lifters.
• Tank shell can also be realigned if it has “settled” over time.
• Supports are welded to the shell and it is aligned with hydraulic tank lifters.
• When shell is aligned, foundation/oil sand is repaired.
Method 2
Replace bottom and realign exist. foundation

New annular plates:
• New annular plate is installed, first one in the middle of the area and tag welded to shell
• Next plate is installed to the one side, the next to the other side and following in both direction in parallel.
• The annular plates are tack welded until the entire circumference is installed.
• The butt welds between the annular plates are welded from the inside as far as possible and afterwards from the outside. It must be ensured that the welds are in its entirety also under the shell!
• Finally the new annular is welded to the shell starting from the outside.

New bottom:
• Same procedure as for Method 1
Method 3
New double-bottom by ”envelope”-method

Preparation:
• Brackets are welded on the outside of the shell covering the slot for the new annular.
• A slot for the new annular is made on the entire periphery.
Method 3
New double-bottom by "envelope"- method

New annular:
- Oil gravel/sand is laid out and vibrated in the annular area
- New annular plates are installed and tack welded.
- When the entire annular ring is installed butt welds between annular plates are completed
- The brackets on the outside can now released
- Annular is now welded to the shell.

New Bottom:
- Oil gravel/sand is laid out with slope and vibrated
- Bottom plates are installed as in method 1
## Case Study

### New bottom and new foundation

<table>
<thead>
<tr>
<th>Type of contract:</th>
<th>Turnkey</th>
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</thead>
</table>
| Milestones:      | Award December 2016  
                  | Delivery January 2017, **11 days** |
| Disciplines:     | Design, Engineering, Calculations,  
                  | Procurement, Erection and testing |
| HSE:             | No incidents |
| Remark:          | Delivery on schedule! |

### Scope of work

- Exchange of complete bottom with new asphalt layer on Tank 12
- 640 m³ and 9m diameter
- New foundation
- New tank bottom and annular plate
- Re-install tank on new bottom
- Design according to EN 14015
- Testing according to EN 14015
Case Study
New double bottom and new foundation

Scope of work

- New double bottom
- New annular
- 45,000 m³ volume and 50 m diameter
- Floating roof
- Design according to API 653/650
- Replace nozzles
- Replace floating roof legs
- Testing according to API 650
- Hydro testing

Type of contract: Turnkey
Size of contract: 7,000 man-hours
Milestones: Award September 2016
Delivery November 2016, 8 weeks!
Disciplines: Design, Engineering, Calculations, Procurement, Erection and testing
HSE: No incidents
Remark: Delivery on schedule!
# 3 methods
Comparing, pros and cons

<table>
<thead>
<tr>
<th>Method 1</th>
<th>Method 2</th>
<th>Method 3</th>
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</thead>
<tbody>
<tr>
<td>Replace bottom and new foundation</td>
<td>Replace bottom and realign exiting foundation</td>
<td>Establish new bottom using &quot;envelope&quot; - method</td>
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</tbody>
</table>

**Positive**
- Installation of environmental membran
- Leak detection
- Improved corrosion resistance
- Proper levelling of foundation
- Partly replacement of annular possible
- Lower cost than method 1
- Lower cost compared to M1 and M2
- Fastest solution

**Negative**
- Expensive
- Time consuming
- Require access for crane close to tank
- Slightly reduced volume
- Cost for replacement of shell nozzles
- No possibility to repair foundation