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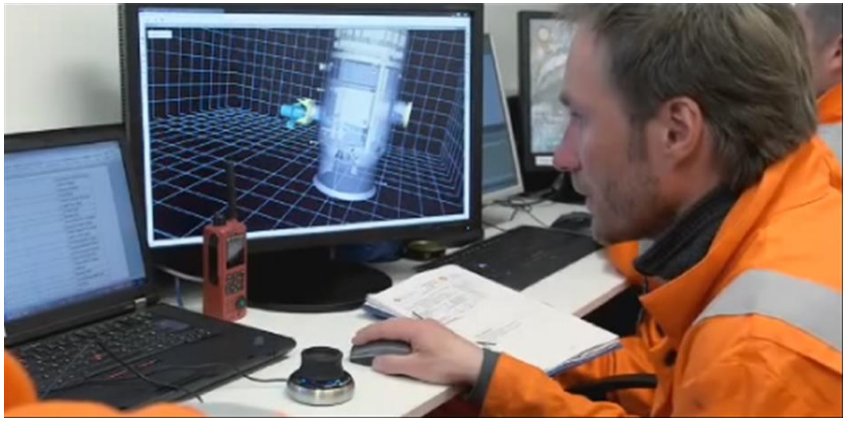


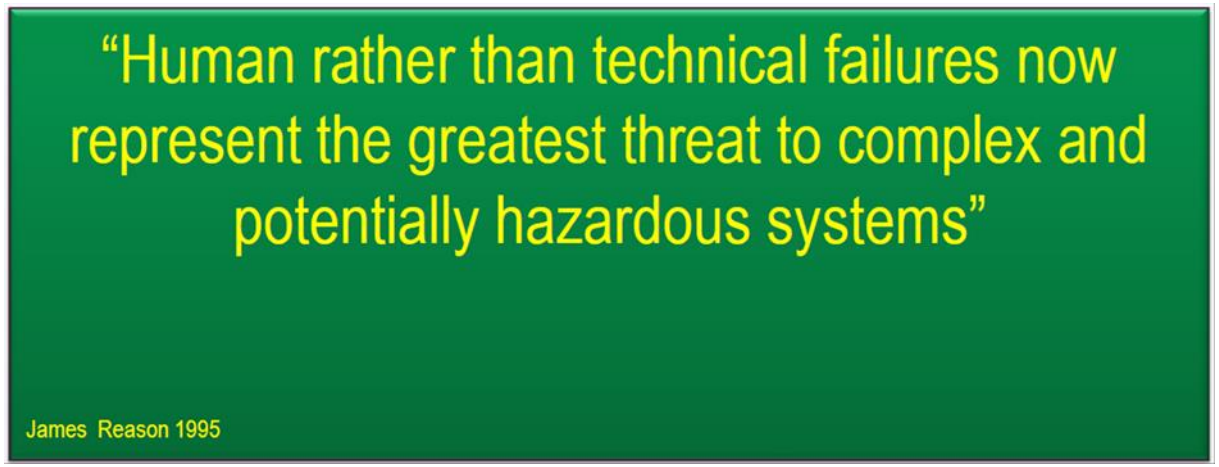
Vessel Inspection

Vessel Inspection

- Entering a confined space is considered as a high risk to personnel. Several life saving rules are related to the entering of confined spaces.

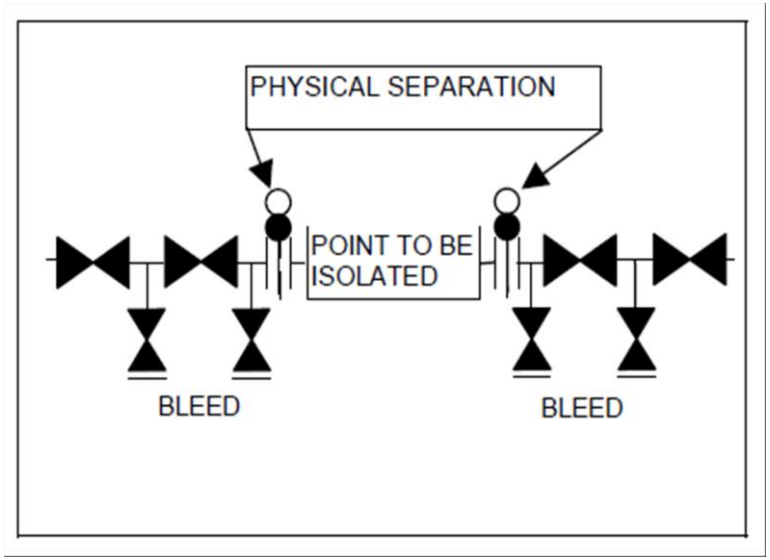
Vessel Inspection - benefits

- Health safety and environment - HSE
  - Exclude human entering of vessels
  - Lifting operations and major scaffolding and isolation work in height eliminated or significantly reduced.
  - The reduced amount of splitting flanges reduces risk for gas leakages during startup

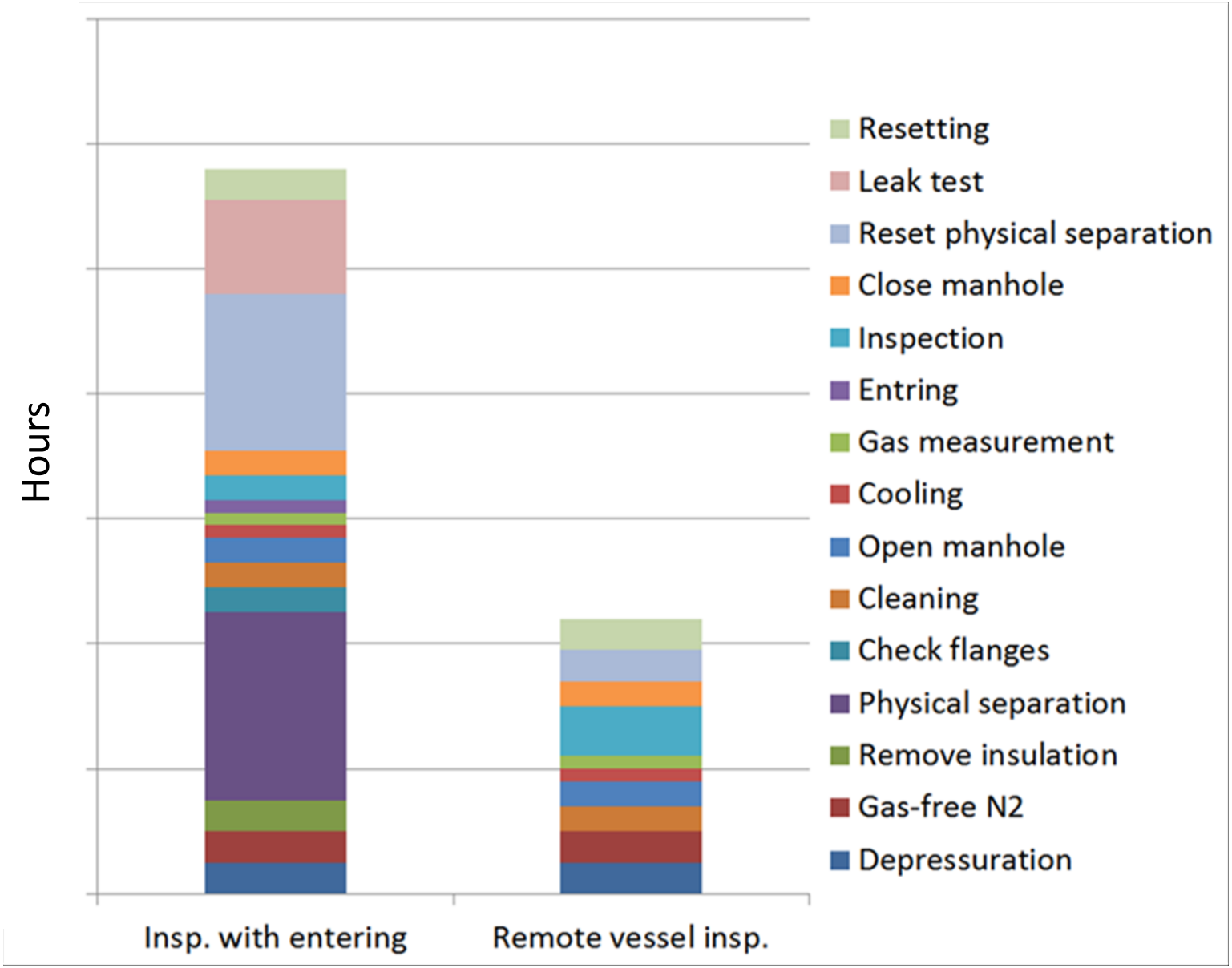


Vessel Inspection - benefits

- Efficiency and cost
  - Reduce man hours to prepare for inspection
  - Potential for reducing the inspection period
  - Potential for reducing shut down time
  - Improved inspection quality and data collection compared to conventional inspection



Vessel Inspection – cost reduction potential



Vessel Inspection – robotic arm – Telbot®

- Camera and light.
- Multiple jointed arm.
- Pre-programmed movements of arm.
- Entry through manhole.
- Full recovery (no loose parts)

Vessel Inspection – robotic arms

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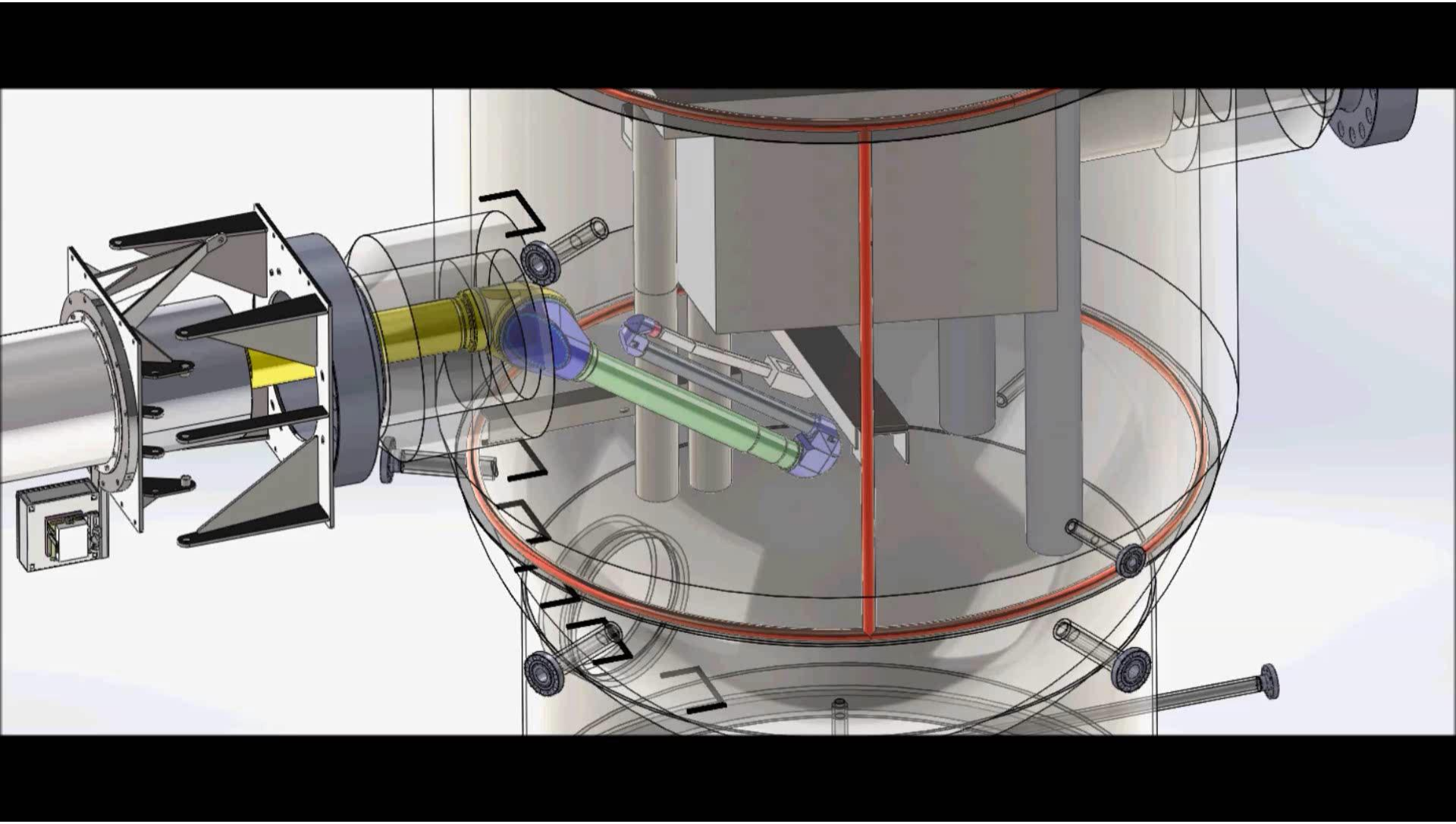
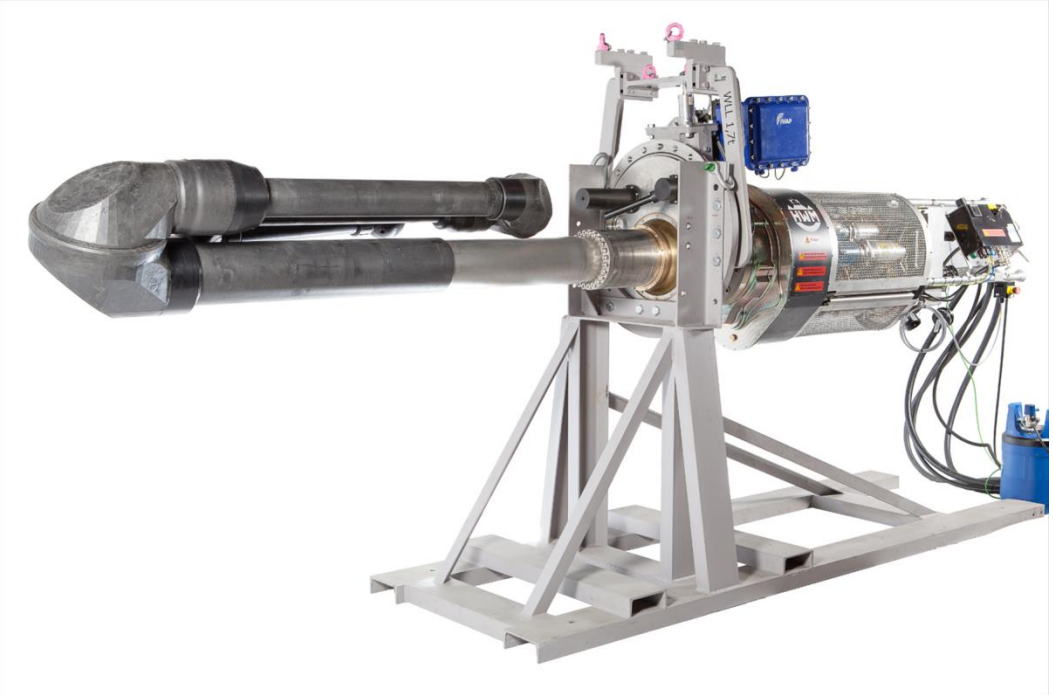


Vessel Inspection – control room container

Vessel Inspection – results

Vessel Inspection – New generation –Telbot®

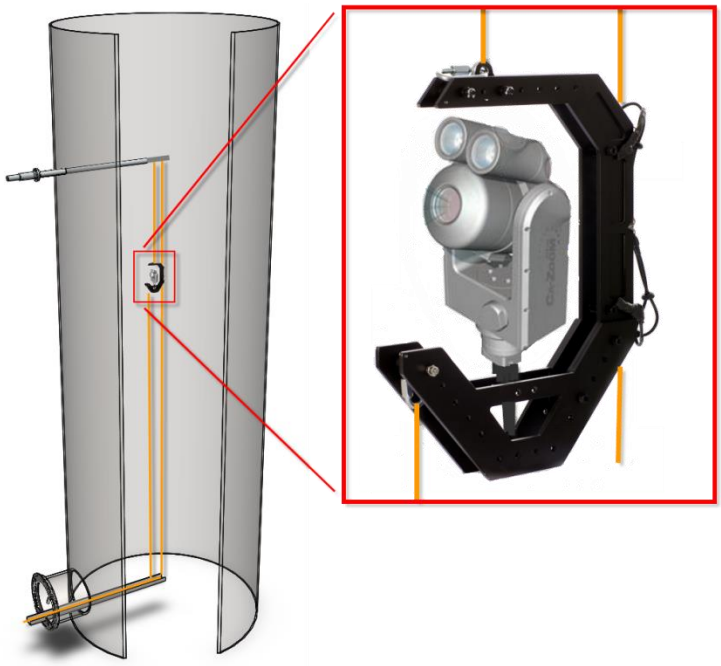
- Telbot® - cleaning and visual inspection
  - ATEX certified
  - Camera for visual inspection
  - Water nozzle for cleaning
  - Remotely operated – manually and with preprogrammed arm movements



Vessel Inspection – New generation –Telbot®

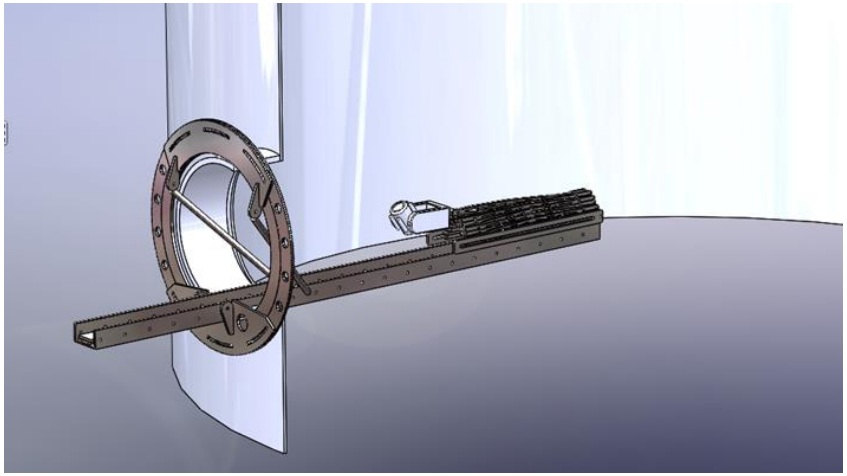
Vessel Inspection – camera lifts

- Guidewires to control movements.
- Access horizontally and vertically.
- Dolly with camera and lights.
- Installation and inspection operated from outside of the vessel.
- Entry through small nozzles (2inc.) and manholes.
- Full recovery (no loose parts).



Vessel Inspection – camera lift - development

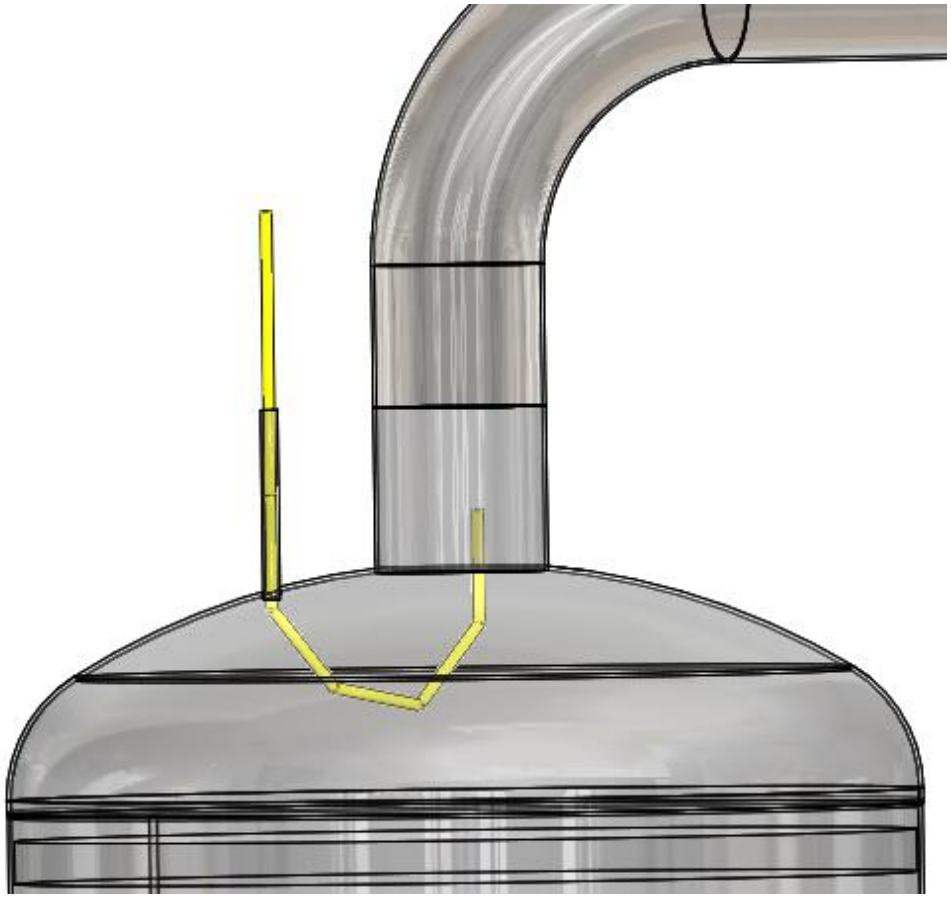
- Single access point - manway
- Efficient installation
- Weight<25kg
- Adjustable – fits different types of camera
- Compact size
- Easy to operate



Vessel Inspection – lattice arm

- Camera and light – videoboroscope (D=6,1 mm.)
- Low weight
- Range - 4 meters
- Positioning of the joints with a remote and manual control system.

Vessel Inspection – lattice arm



Vessel Inspection – references

- 2011: Remote inspection of 1 vessels at Shell's - Ormen Lange (Nyhamna, Norway) onshore processing facilities. Inspection performed using robotic arm – Telbot I.

- 2012: Remote inspection of four vessels at Shell's - Ormen Lange (Nyhamna, Norway) onshore processing facilities. Executed during a planned turn over/shut down. Vessels inspected consecutively over four days using the same equipment, 1 day per vessel. Inspection performed using robotic arm – Telbot I.

- 2013: Remote inspection of two vesselss at Shell's - Ormen Lange (Nyhamna, Norway) onshore processing facilities. Inspection performed using robotic arm – Telbot I.

- 2013: Inspection of four vessels at Statoils – Kårstø (Norway) onshore processing facilities. Inspection performed using a camera lift together with lattice arm.

- 2014: Inspection(demonstration) of two vessels at Shell/NAM's facilities outside Groningen, Netherland. Inspection performed using the Telbot I.

Vessel Inspection – references

- 2011 - 2015: DEMO 2000 Reward: PZL was rewarded with “DEMO2000”s annual allocation of R&D – funding for further development of the remote tank inspection concept. Together with Shell, Statoil and Gassco PZL is now looking for further applications of the concept. Demo 2000 consept to be demonstrated in 2015.

- 2015: Inspection of one vessel at Statoil - Kårstø (Norway) onshore processing facilities. Inspection performed using the Telbot II – developed through the Demo 2000 project.

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