

# Inspection of a filled hot water storage tank using a robot

SIAPWS Annual Meeting 2019  
Helsinki



# Inspection of hot water storage tank at Studstrup Power Plant

## Purpose of the inspection:

- Check for corrosion in general on tank surface and seams
- Analysis of bottom sediment/water
- Check for corrosion in the bottom welding seam

## SSV tank conditions:

- 27.000 m<sup>3</sup> of water
- Operating temperature = 125 °C
- Tank height = 54,80 m
- Min. water level = 45,90 m
- Max. water level = 50,58 m



SSV hot water storage tank

# Why using a ROV? (ROV = Remotely Operated underwater Vehicle)

- No need for emptying the tank
- ROV Phantom XTL, operated by ROV Support A/S, can operate in 80 °C hot water
- Minimal costs for cooling the water (125 °C → 80 °C)
- No costs for production of new water after inspection
- Use of suction device for taking water/sediment samples



Suction pipe

# ROV setup



Manhole on top of tank  
Suction hose and power cord  
Camera  
Light  
Suction pipe



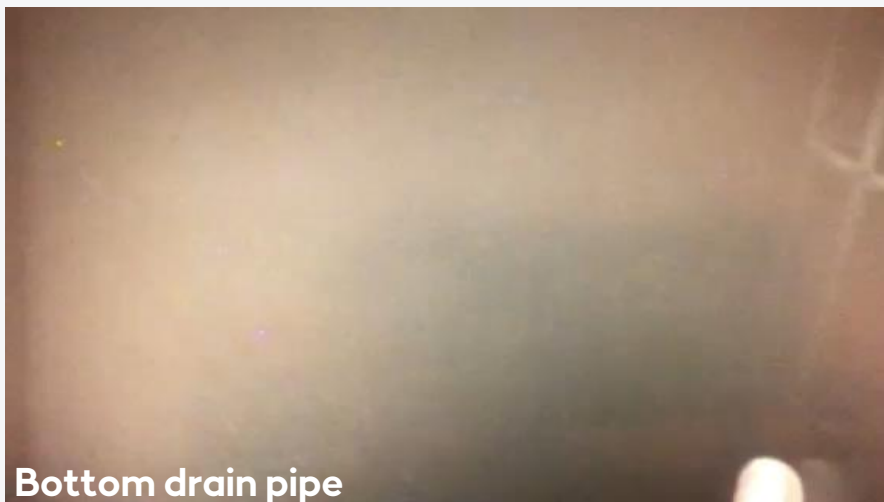
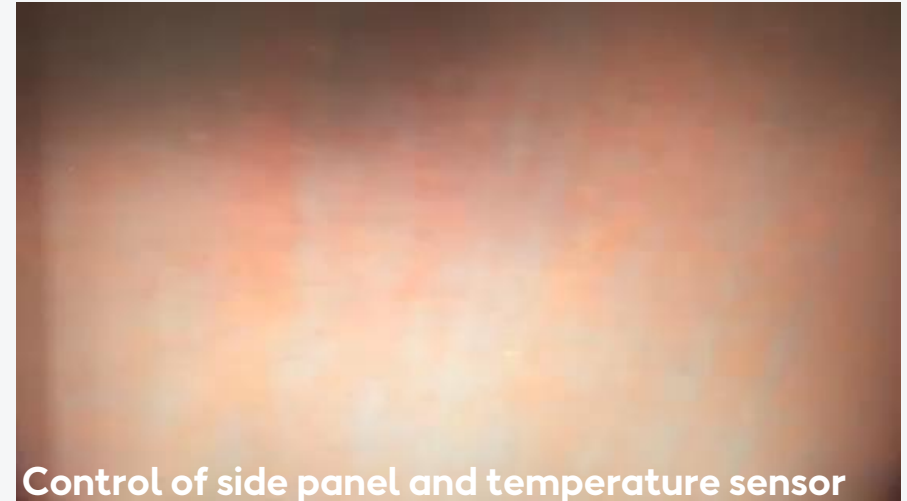
ROV ready for lift-off



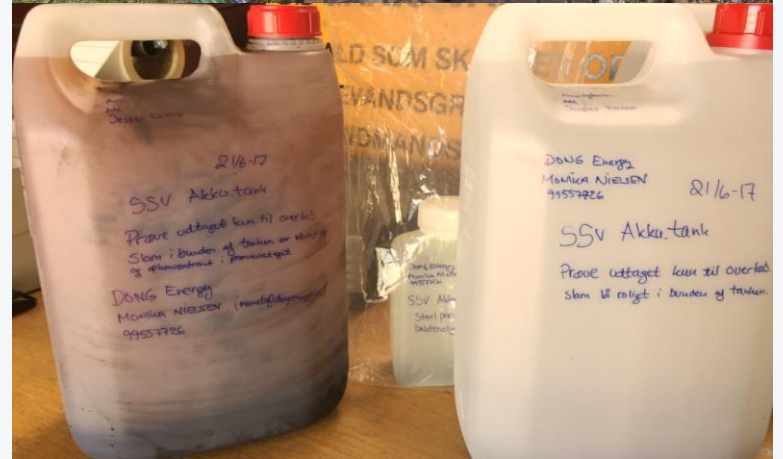
Sludge exhauster for extraction of sediment samples

BMS crane for lifting the ROV to top of storage tank

# Video documentation of findings



# Sampling of sediment



# Analysis results of bottom sediment and water

## Bottom sediment sample

Analyseparameter	Resultat
pH	<b>8.74</b> pH
Tørstof	<b>6.58</b> %
Ammoniak-N	<b>19</b> mg/kg TS
Total-N	<b>130</b> mg/kg TS
Jern	<b>655000</b> mg/kg TS
Mangan	<b>7880</b> mg/kg TS
Natrium	<b>&lt;3</b> mg/kg TS
Kalium	<b>&lt;2</b> mg/kg TS
Chrom	<b>129</b> mg/kg TS
Nikkel	<b>249</b> mg/kg TS
Cadmium	<b>1.14</b> mg/kg TS
Bly	<b>17.4</b> mg/kg TS
Kobber	<b>177</b> mg/kg TS
Zink	<b>97</b> mg/kg TS
Kviksølv	<b>&lt;0.1</b> mg/kg TS
Sulfid	<b>1.4</b> mg/kg TS
Kimtal 22°C	<b>160</b> pr. mL
Kimtal 37°C	<b>82</b> pr. mL
Sulfitred. anaerobe bakterier	<b>&lt;1</b> CFU/mL
Kimtal 44°C	<b>310</b> pr. mL

Fe = app. 99 % →

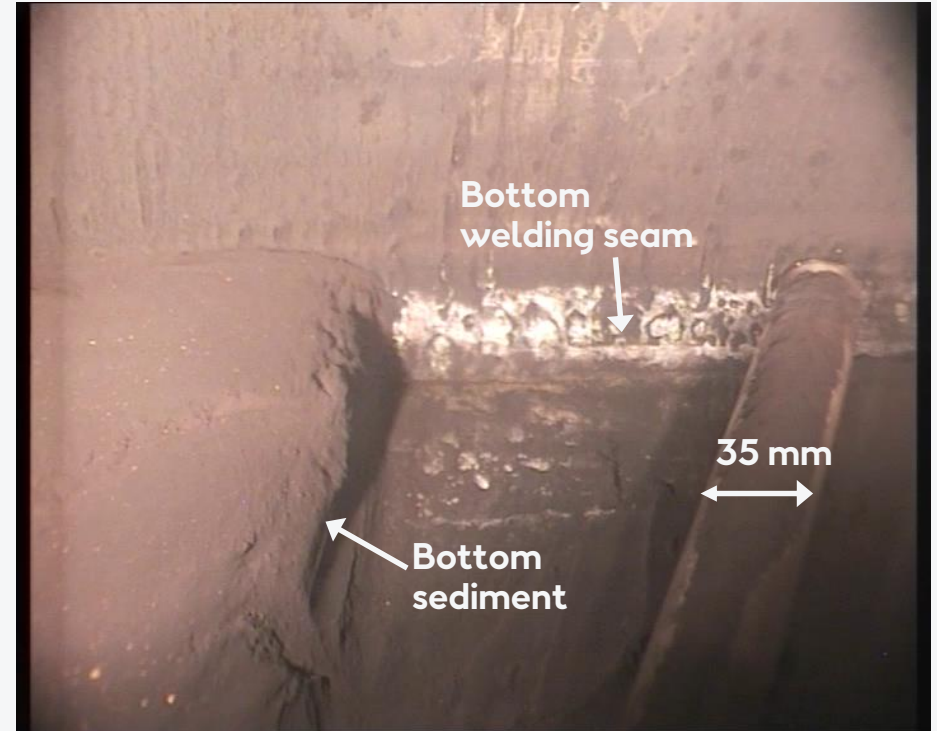
## Water sample

Analyseparameter	Resultat
Sulfitred. anaerobe bakterier	<b>&lt;1</b> CFU/mL
Kimtal 22°C	<b>120</b> pr. mL
Kimtal 37°C	<b>24</b> pr. mL
Kimtal 44°C	<b>60</b> pr. mL

Conclusion from analysis results:

- 99 % of the sediment consists of Iron
- No sulfate-reducing bacteria
- No indication of microbial induced corrosion

# Inspection of bottom welding seam



Conclusion of the visual inspection of the tank:

- The tank looks as good as new
- No signs of corrosion



## Why so much bottom sediment?

Sediment height in Studstrup storage tank was app. 50-100 mm

Oxygen in makeup water for the district heating system is high!!

High O<sub>2</sub> in makeup water causes high levels of corrosion products in district heating systems!!



Sediment height in Skærbæk storage tank was app. 10-20 mm

Oxygen in makeup water for the district heating system is low!!

Low O<sub>2</sub> in makeup water keeps low levels of corrosion products in district heating systems!!



Thank you for your attention 😊