



# Statoil Topside Sand Management

Focus areas & technology development

Jørg Holm – 11th March 2010

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# Content of presentation

- Statoil sand management strategy
- Technology focus
- Inline Desander Qualification
- Heidrun pilot installation
- Test results
- Summary

# Statoil sand management strategy – Authority requirements

- Statoil honour the World Bank Group Environmental guideline
  1. Transport sand to shore for treatment and disposal, or route to offshore disposal well
  2. < 1 wt% oil on dry sand for sand discharged to sea (not good practice)

# Statoil sand management strategy - Sand production strategy

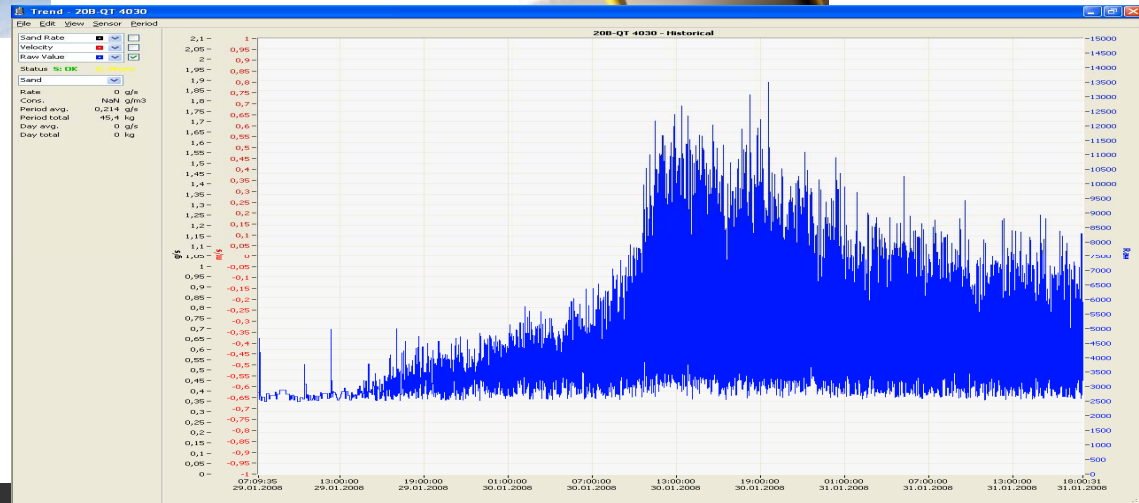
- On several fields Statoil produce according to Maximum Sand Free Rate strategy
- Ambition – Acceptable Sand Rate
  - Develop field specific limits for sand production
  - Quantify sand production with increased accuracy
  - Control, measure and monitor erosion



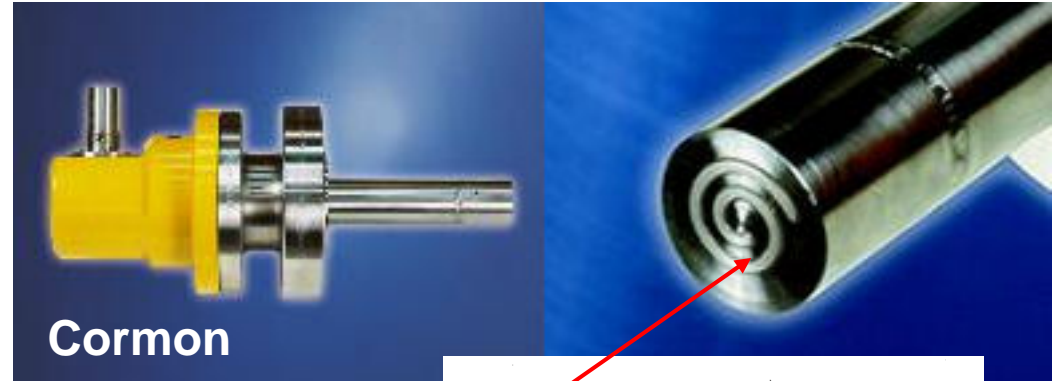
# Statoil sand management strategy - Technology focus

- Detection
  - Improved understanding of response to sand for existing equipment
  - Develop in-house support to operations
- Cleaning
  - Focus on the environmental impact of jetting sequence
- Separation
  - Technology qualification of bulk separation equipment

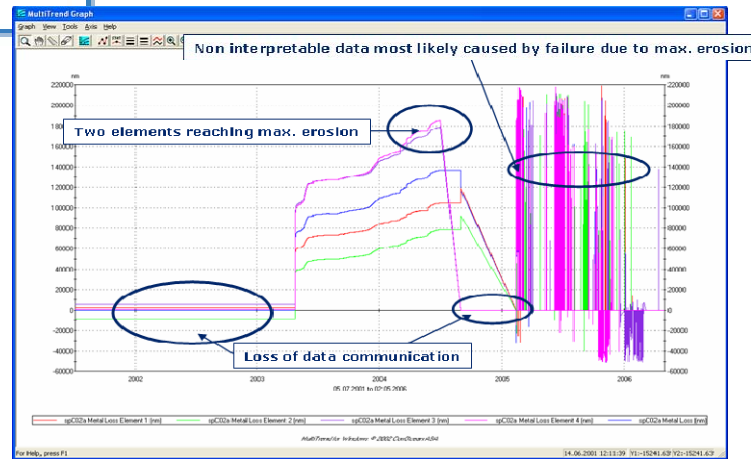
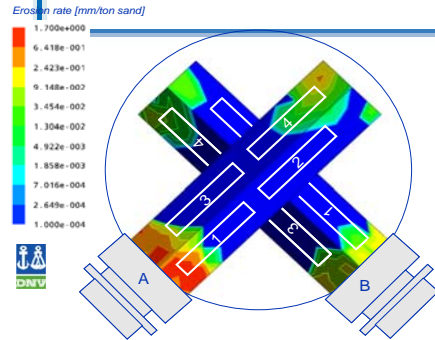
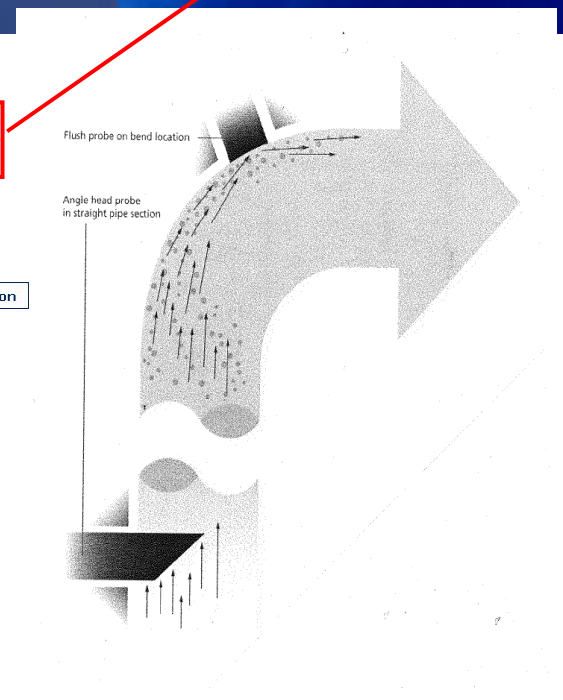
# Technology focus – Detection - Acoustic



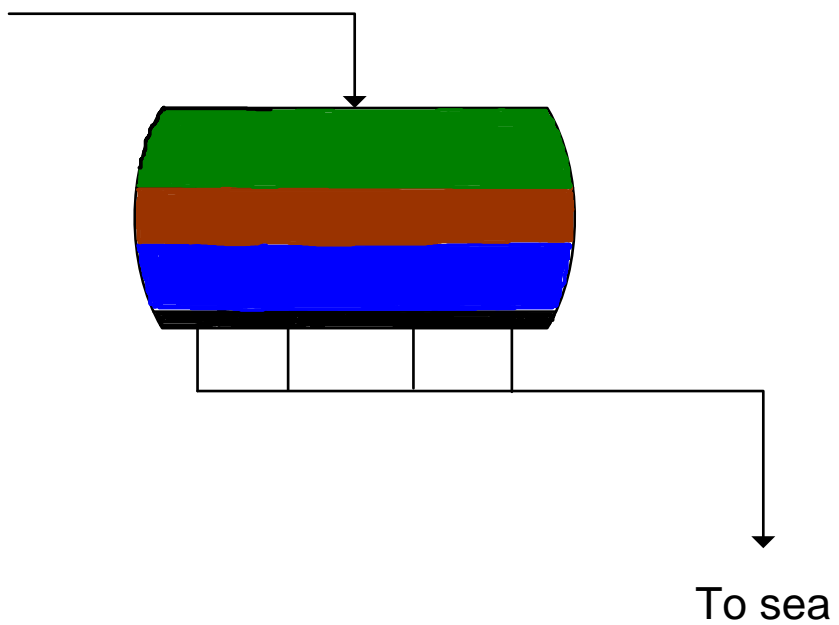
# Technology focus – Detection – ER probes



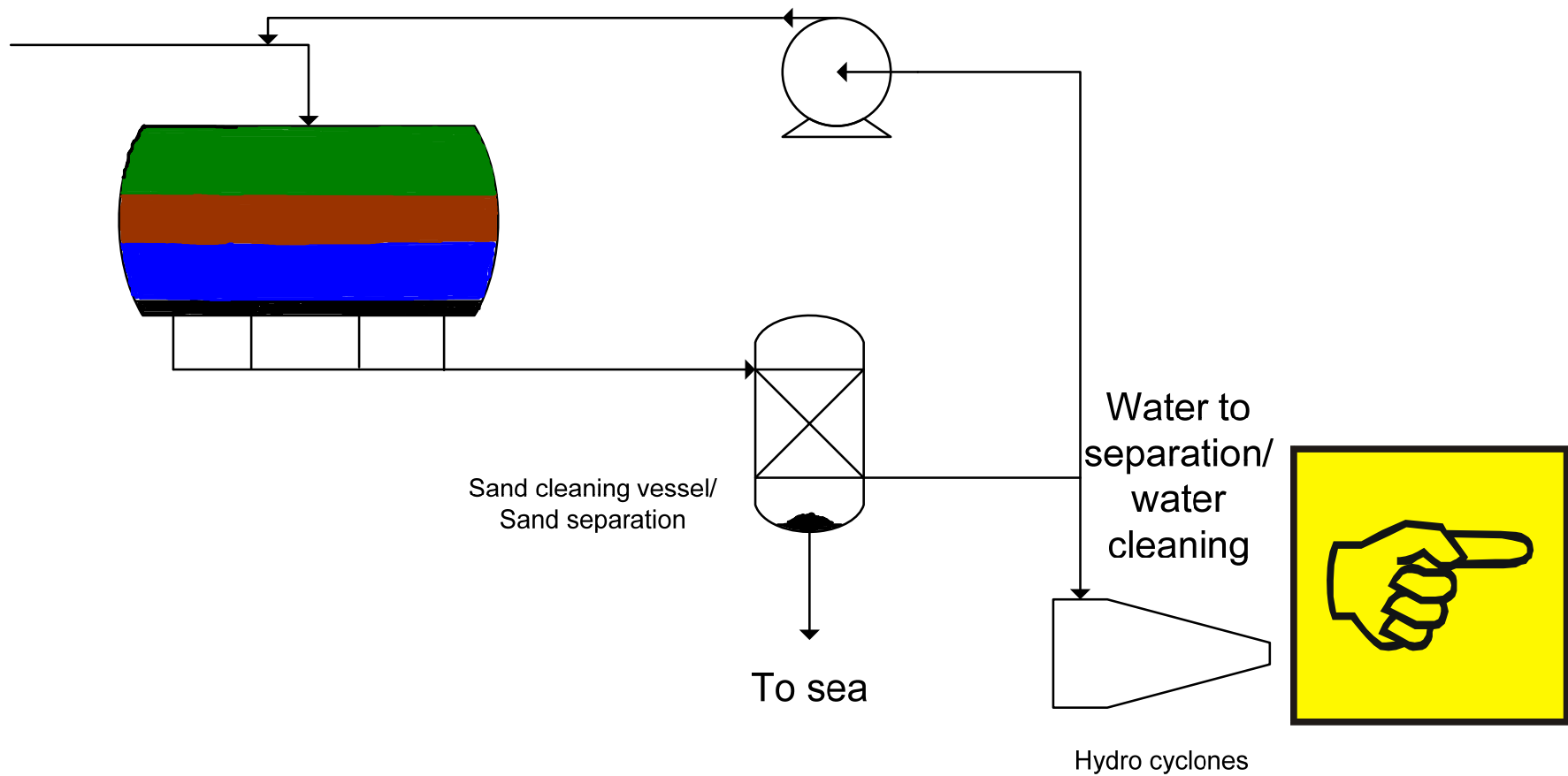
Erosion element(s)



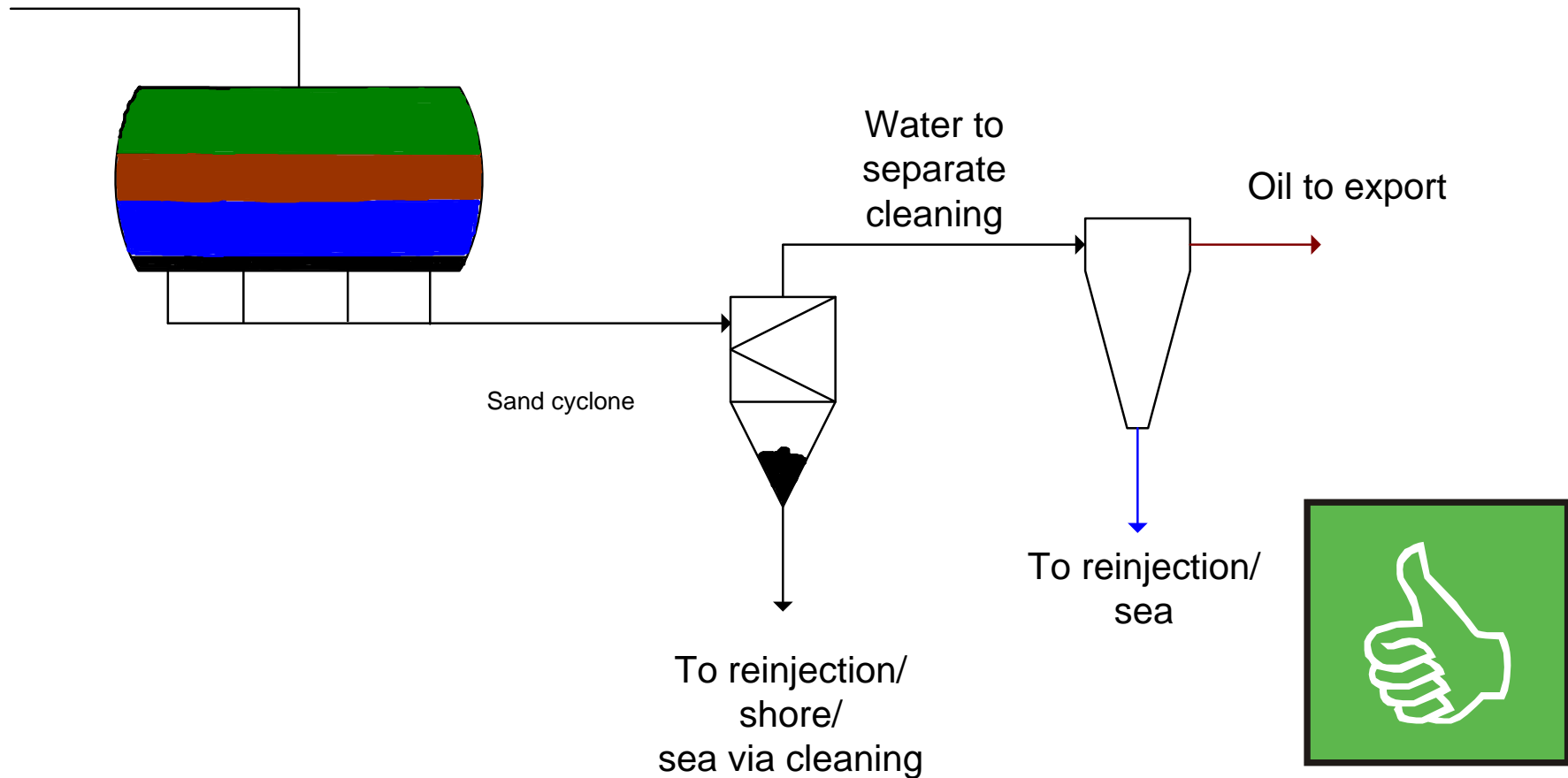
# Technology focus - Cleaning



# Technology focus - Cleaning

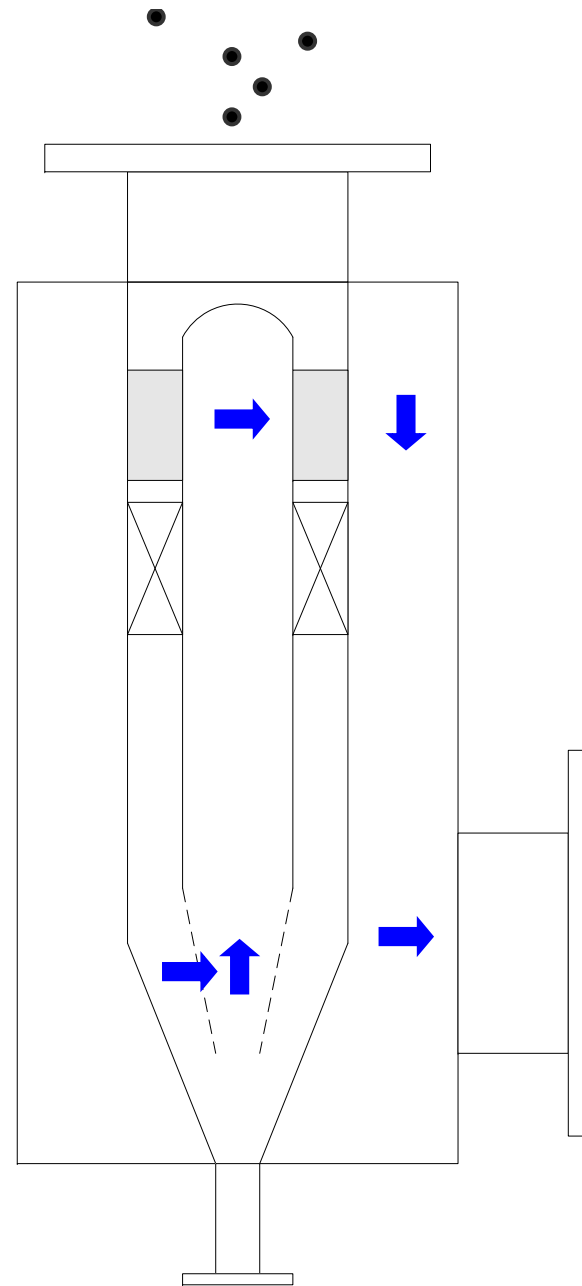


# Technology focus - Cleaning

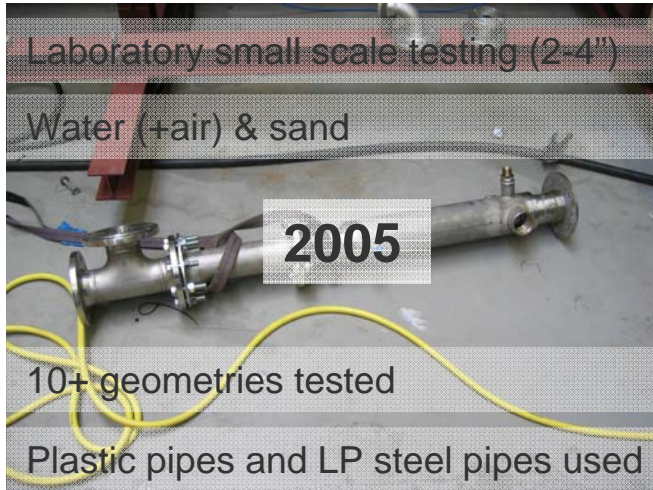


# Technology Focus – The inline technology

- Background from axial cyclon boxes in scrubbers
- Axial cyclone inside pipe
- Pipe in pipe design



# Technology development – Statoil CDS Inline desander



Large scale testing 10" & 12"



Offshore pilot unit Heidrun

**2008-2009**



**2005**

**2006**

**2008**

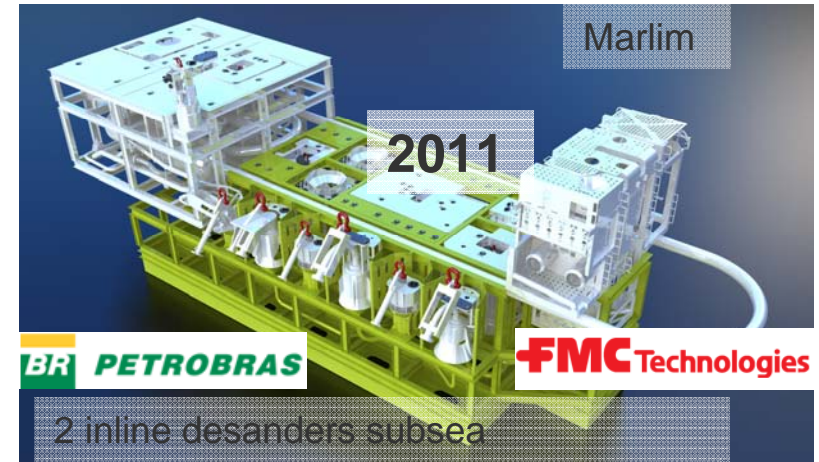
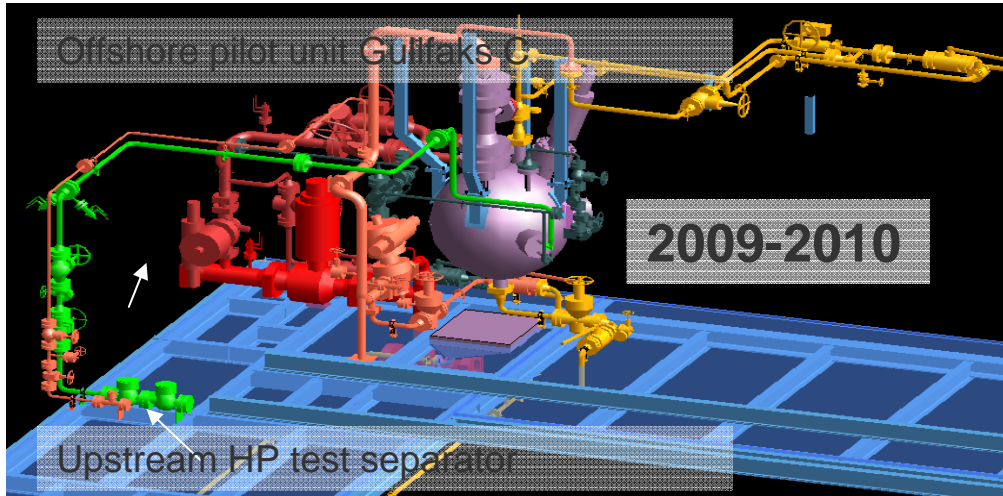
**2009**

**2010**

**2011**



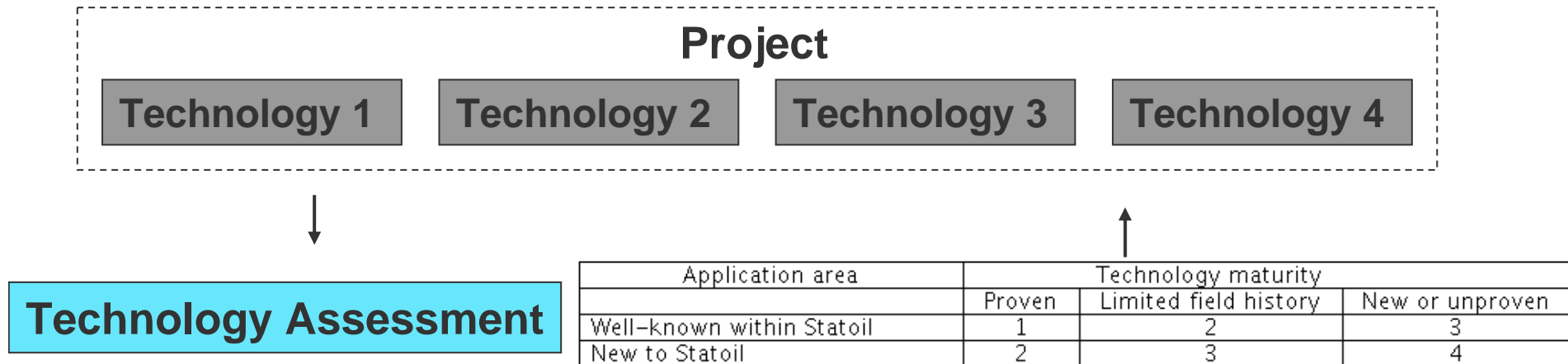
# Technology development – Statoil CDS Inline desander



2005    2006    2008    2009    2010    2011



# Technology qualification procedure



# Technology qualification procedure

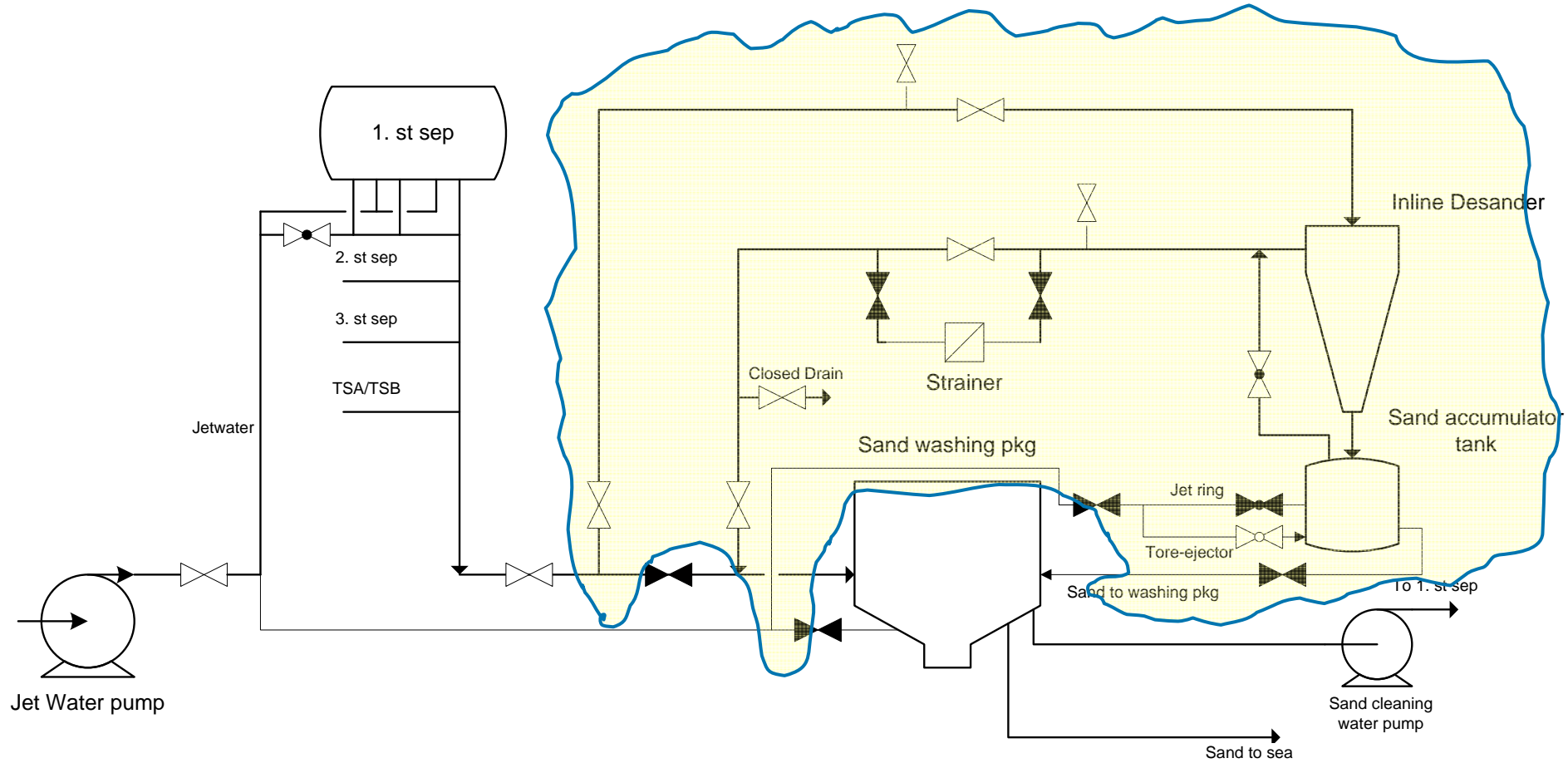
Level	Development stage	Description
TRL 0	Unproven Idea	Paper Concept. No analysis or testing has been performed
TRL 1	Analytically Proven Concept	Functionality proven by analysis , reference to common features of existing technology or testing on individual subcomponents /subsystems. The concept may not meet all of the technical requirements at this level, but demonstrates the basic functionality with promise to meet all the requirements with additional testing.
TRL 2	Physically Proven Concept	Concept design or novel features of design validated by model or small scale testing in laboratory environment. The system validates that it can function in a "realistic" environment with the key environmental parameters simulated.
TRL 3	Prototype Tested	Full scale prototype built and put through product qualification test program. The prototype is tested in a robust designed development test program over a limited range of operating conditions to demonstrate is functionality
TRL 4	Environment Tested	Full scale prototype (or production unit) built and put through a qualification test program in (simulated or actual) intended environment
TRL 5	System Integration Tested	Full scale prototype (or production unit) built and integrated into intended operating system with full interface and functionality tests
TRL 6	System Installed	Full scale prototype (or production unit) built and integrated into intended operating system with full interface and functionality test program in intended environment. The technology has successfully operated < 10% of its expected life.
TRL 7	Proven Technology	Production unit integrated into intended operating system. The technology has successfully operated with acceptable performance and reliability for > 10% of its specified life.

# Technology qualification procedure

## Technology Qualification Program

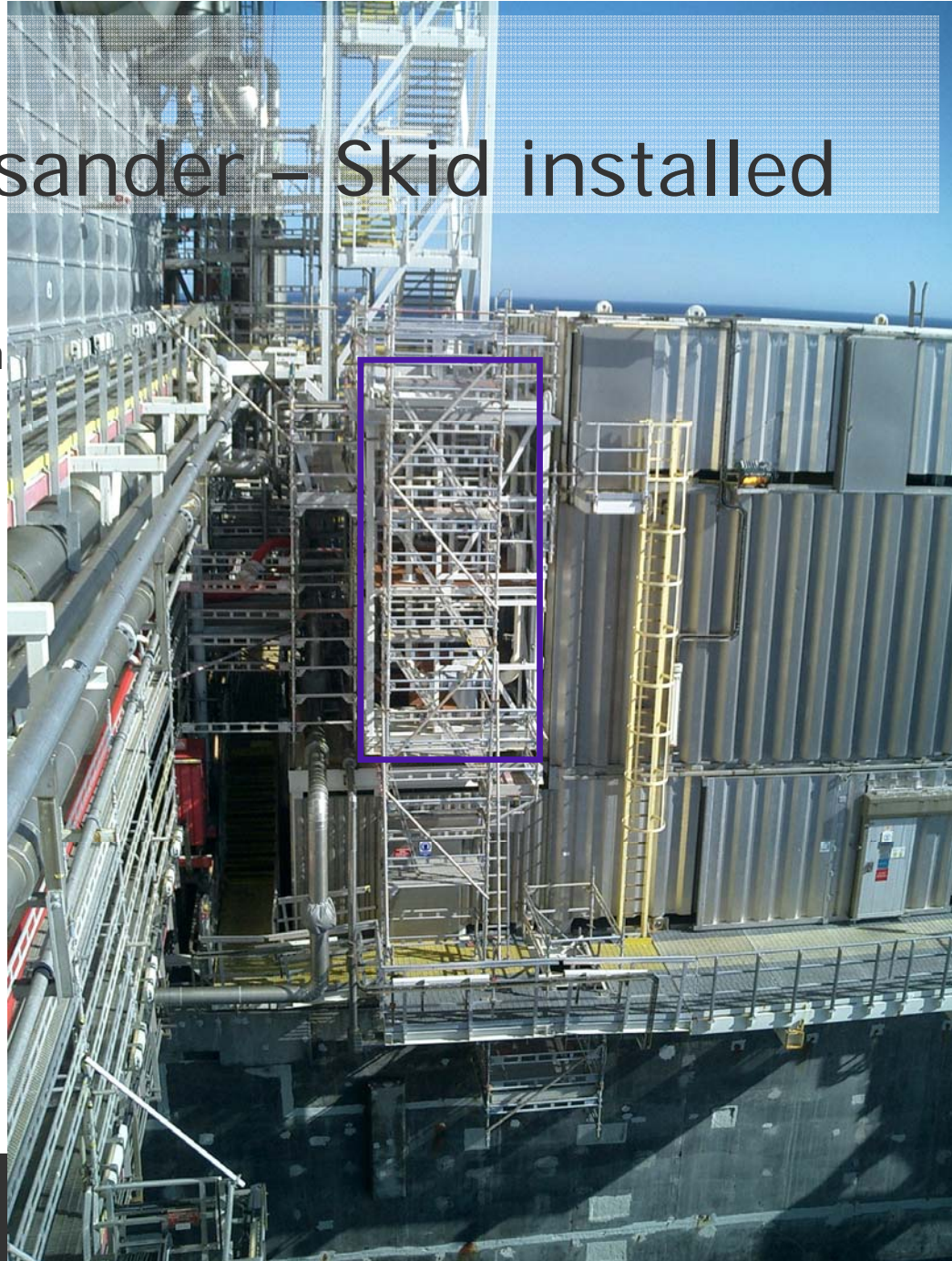
- Activities
- Acceptance criteria
- Constructability
- Maintainability
- HSE
- Cost

# Heidrun inline desander – Flow diagram

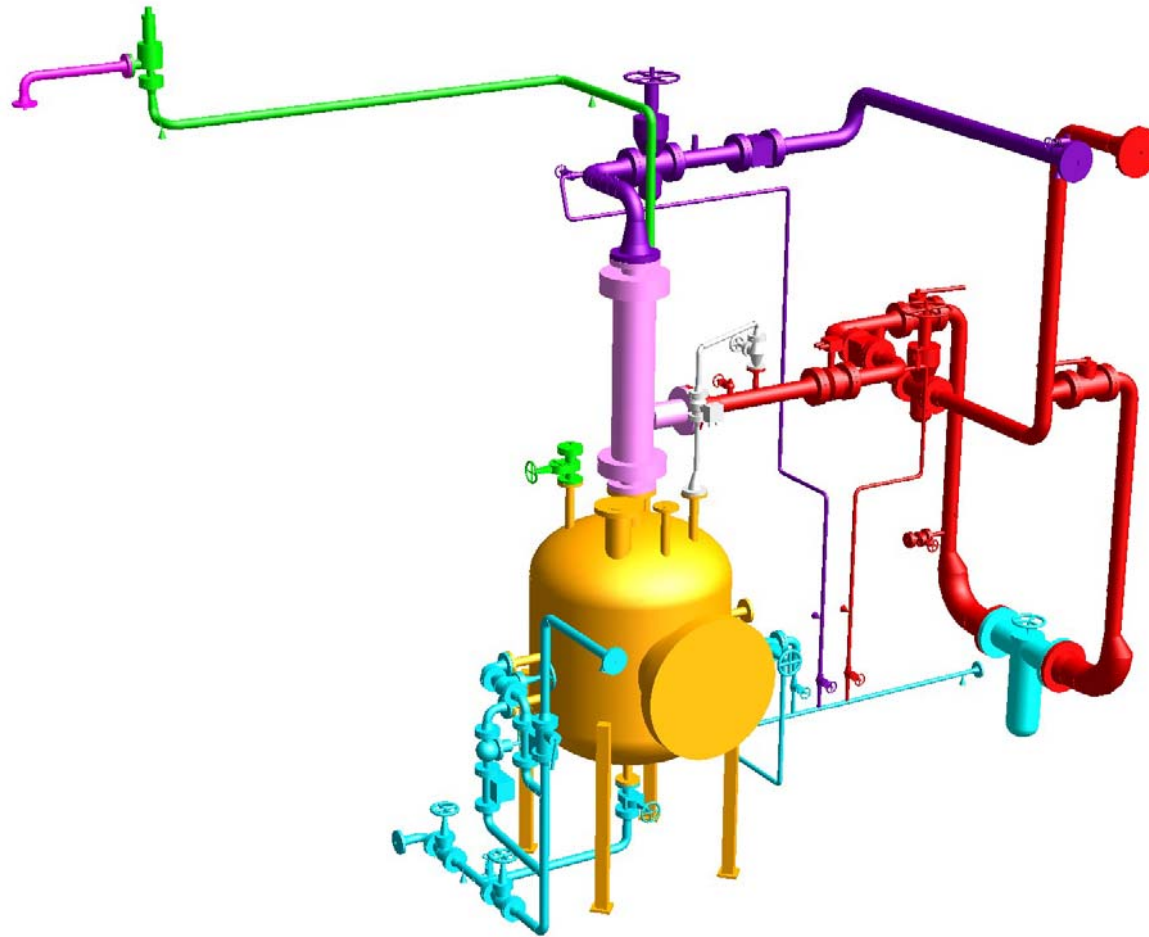


# Heidrun inline desander – Skid installed

- Pilot skid installed at Heidrun



# Heidrun inline desander - Layout



# HD Inline Desander – Desander installed



# HD Inline Desander – Sand accumulator vessel



Classification: Internal



# Technology qualification program

- Acceptance criteria

- > 80% separation efficiency @ design flow (60 m<sup>3</sup>/h)
- > 50% separation efficiency @ turndown point (40% of design flow)
- Max pressure drop = 0,5 bar @ design flow
- Acceptable mechanical wear (by inspection in cooperation with vendor)
- Acceptable efficiency deterioration (< 2% after 6 months of operation)

Acceptance criteria

- Verify operability

- Raise technology to next TRL (Technology Readiness Level)

- Verify data from the large scale laboratory tests

- Check influence oil-on-sand levels for the Heidrun sand to sea

- Gain experience and data for future installation

# Test program – Short term

- Type of sand = 160, 190, 270 micron + Heidrun sand
- Flow rate = 20% - 100% of design flow
- Measurement principle
  - Injection of sand and extraction by vacuum cleaner
  - Measurement by ClampOn acoustic sand monitor
- Type of tests
  - Injection of ~ 15 kg sand and extraction followed by weighing
  - Factorial test set up (Flow rate, Sand type, GVF & reject rate)
  - Jetting operations

3 month period

# Test program - Long term testing

- Heidrun operations operated the pilot installation during jetting
  - 3-4 months
  - Operational experience with the equipment
  - Long term effects (scaling, plugging, deterioration)
- Long term testing followed by Technology Acceptance tests
  - Less than 2% efficiency deterioration
  - Splitting of desander
  - Inspect internals in cooperation with the vendor

# Summary

- Statoil has a sand management strategy
  - Fulfil authority requirement
  - Control and handle sand
- The desander works and fulfils the acceptance criteria
  - Results show almost 90% of all sand is removed at design point
  - Minimum 60 % of sand removed at flow rate = 40% of design (=24 m<sup>3</sup>/h)
  - Pressure drop ~ 0,3 bar @ design point
  - No deterioration seen from long term testing

# References

- World Bank Group HSE Guidelines

- [http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui\\_EHSGuidelines2007\\_OffshoreOilandGas/\\$FILE/Final+-+Offshore+Oil+and+Gas+Development.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_OffshoreOilandGas/$FILE/Final+-+Offshore+Oil+and+Gas+Development.pdf)

- Norwegian Petroleum Safety Authority (PSA)

- [http://www.ptil.no/getfile.php/Regelverket/Aktivitetsforskriften\\_e.PDF](http://www.ptil.no/getfile.php/Regelverket/Aktivitetsforskriften_e.PDF)



# Thank you

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