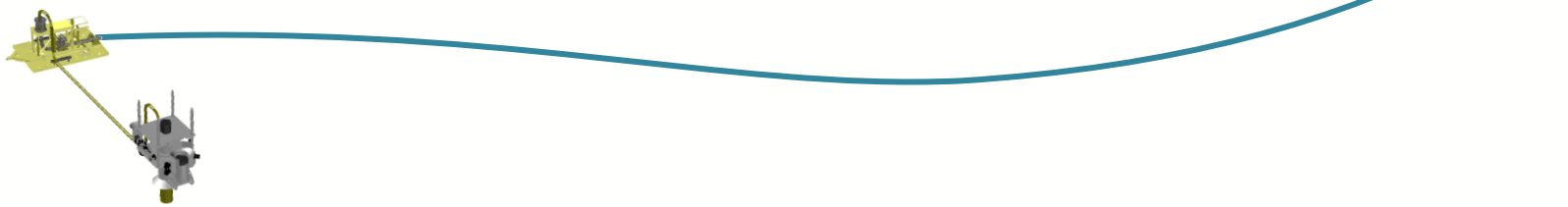
Summary of an Offshore Inspection Campaign with Subsea CT Scanning Technology

Jason Harry

Overview

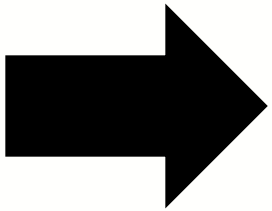
- December 2014 offshore integrity campaign
- Corrosion assessment of ~7 year old flowline
- Increasing water cut, uncertain corrosion models
- Single well, 6” tieback targeted for extended life
  - ~1,650’ water depth, ~3 miles to Host
- Volumetric metal loss known, but CT imaging used to confirm wall thickness

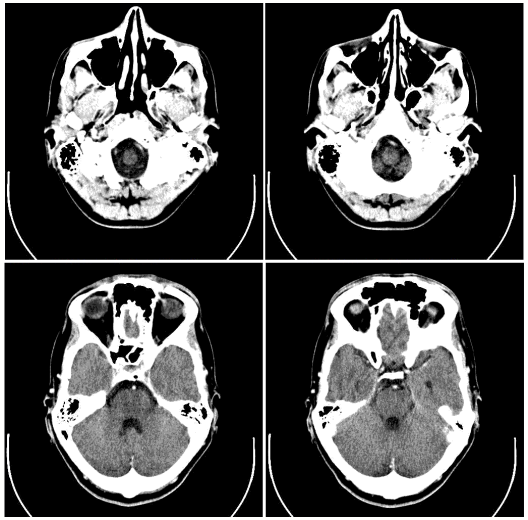


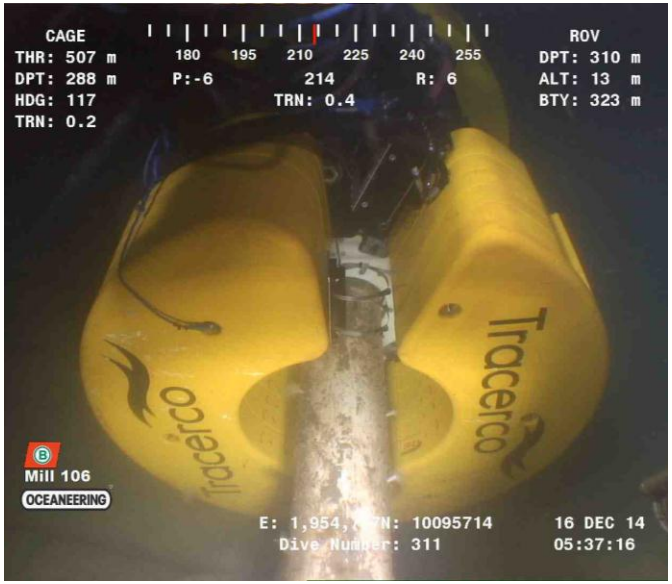
Motivation

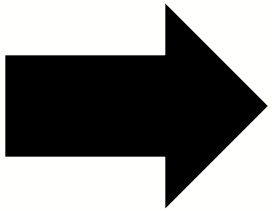
- Deliver value by ensuring integrity for extended life
- Needed non-intrusive, detection under insulation, no impact to production
- Pulsed Eddy Current (PEC) in 2013
  - Results positive, but volumetric only (no w.t. data)
- Re-validate / baseline corrosion models after water breakthrough

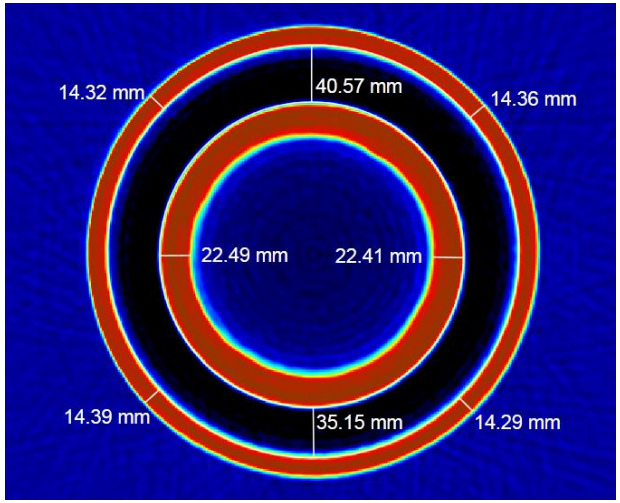

SIEMENS





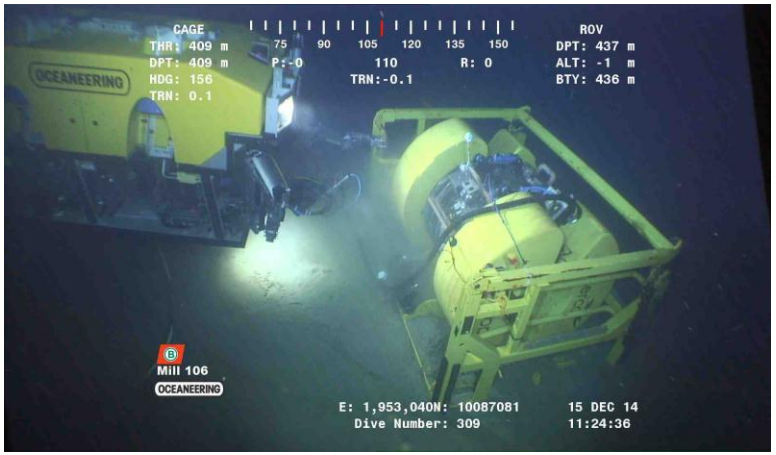

CAGE
THR: 507 m
DPT: 288 m
HDG: 117
TRN: 0.2
180 195 210 225 240 255
P:-6
214
TRN: 0.4
R: 6
ROV
DPT: 310 m
ALT: 13 m
BTY: 323 m
Tracerco
Tracerco
Mill 106
OCEANEERING
E: 1,954,
N: 10095714
Dive Number: 311
16 DEC 14
05:37:16




14.32 mm
40.57 mm
14.36 mm
22.49 mm
22.41 mm
14.39 mm
35.15 mm
14.29 mm

Subsea CT Scanning Tool

- New technology – 1st of its kind
- Hess – 2nd operator to use in GOM
- Non-intrusive, no impact to production
- ROV deployed
- Scan up to 27” OD with insulation (radial)
- 15 mm scan cross-section (longitudinal)
- Resolution +/- 1 mm (w.t.)



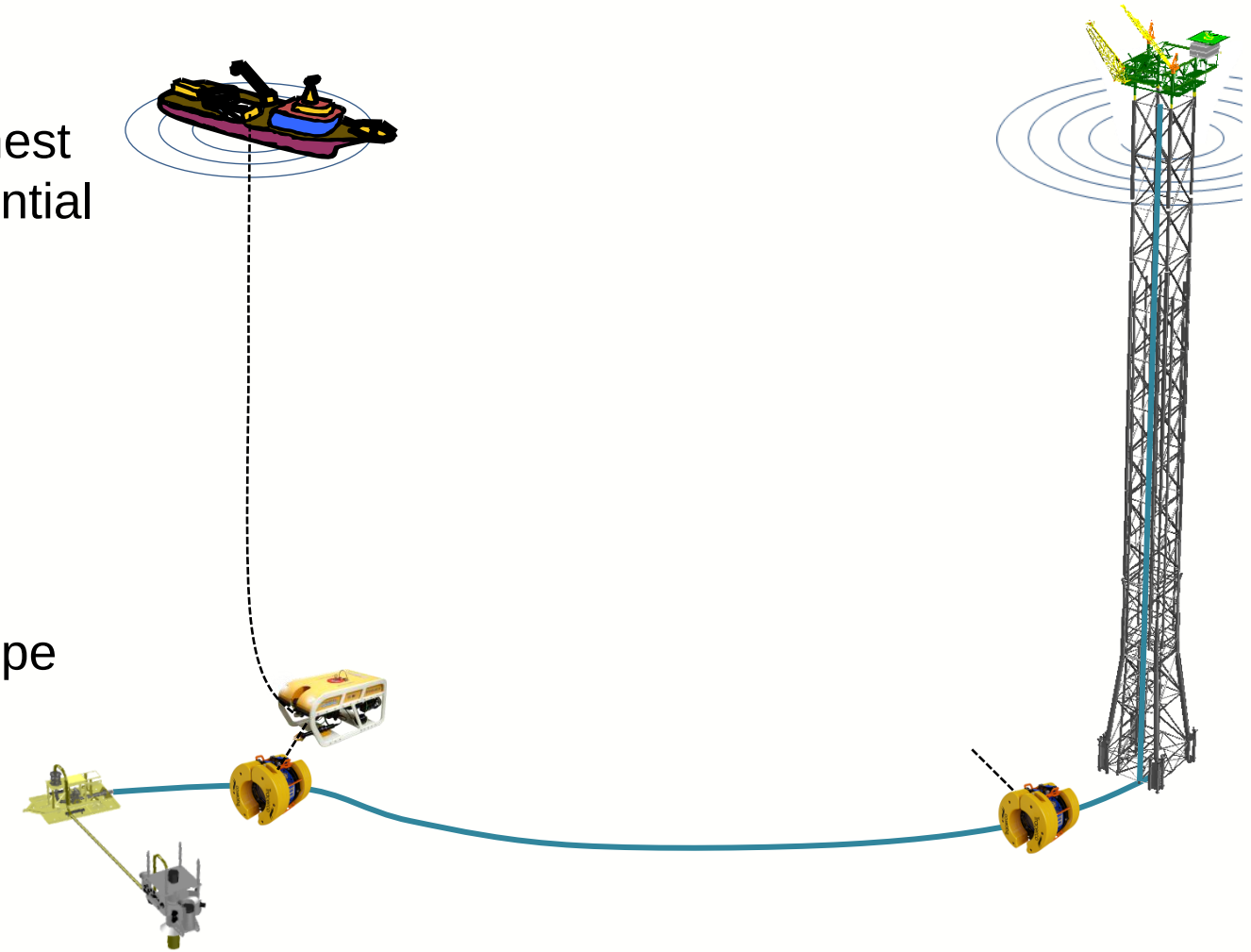
Mobilization

- December 2014 campaign
- Hess hired Multi Service Vessel (MSV)
- CT scanning techs on board
- Deployed by crane in subsea deployment cage

CT Scan Locations

**3 Scan Locations – 4 Scans/Location*

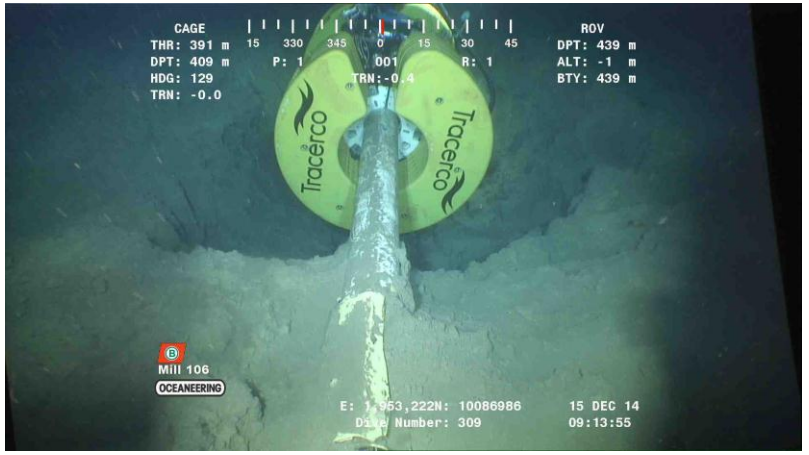
1. Near PLET
   - Warmest, highest corrosion potential
2. Riser Base
   - Most liquid accumulation
3. Riser
   - Thicker wall pipe



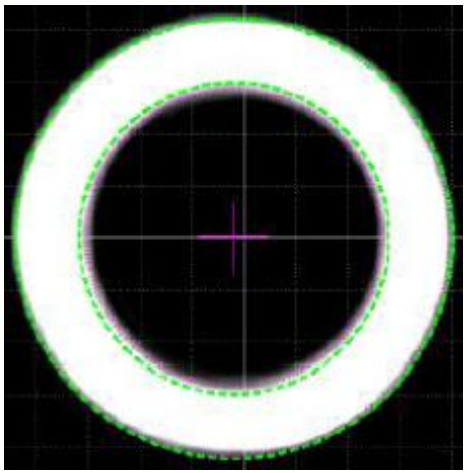
*Locations consistent with PEC volumetric measurements

Site Prep

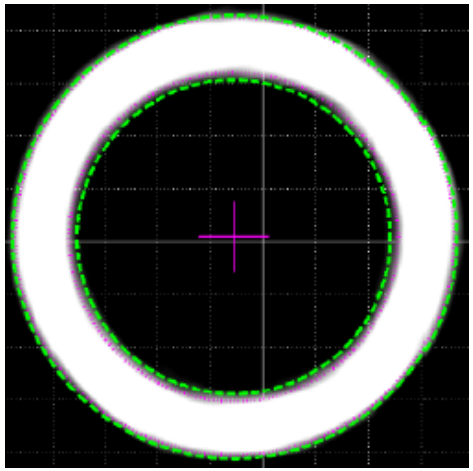
- Either lifting or dredging is typically required
- Elected to dredge with ROV pump
- ~1 day on each location for tool clearance
  - < 2 hours for each set of scans (4 scans/location)



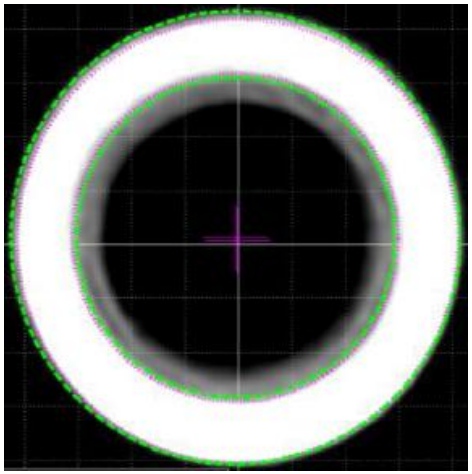
Wall Integrity Results



Riser: < 10% loss



Riser Base: < 10% loss

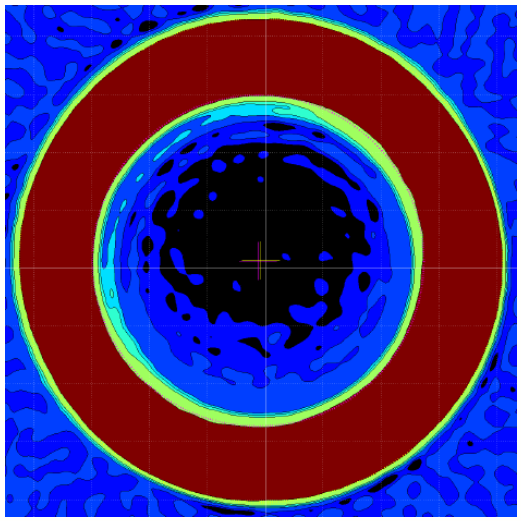


PLET: 0 to 14% loss

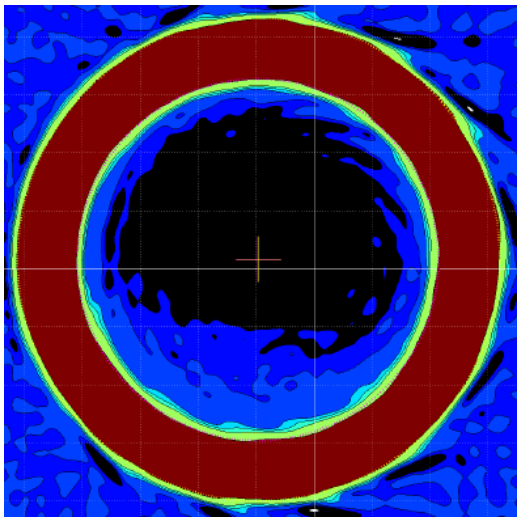
- No evidence of accelerated internal corrosion
- Confirmed PEC data and field life extension
- Flow assurance became more of a concern

Nominal wall

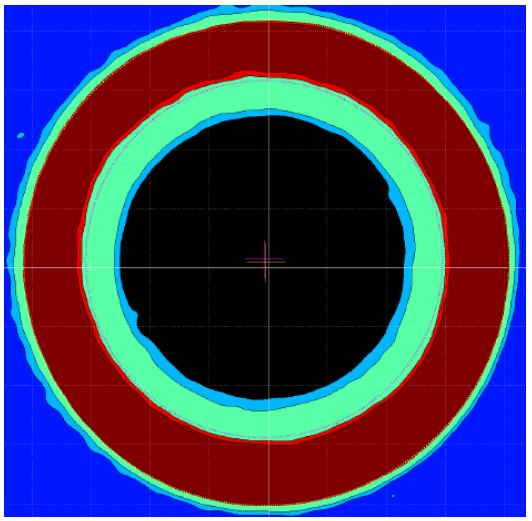
Flow Assurance Results



Riser



Riser Base

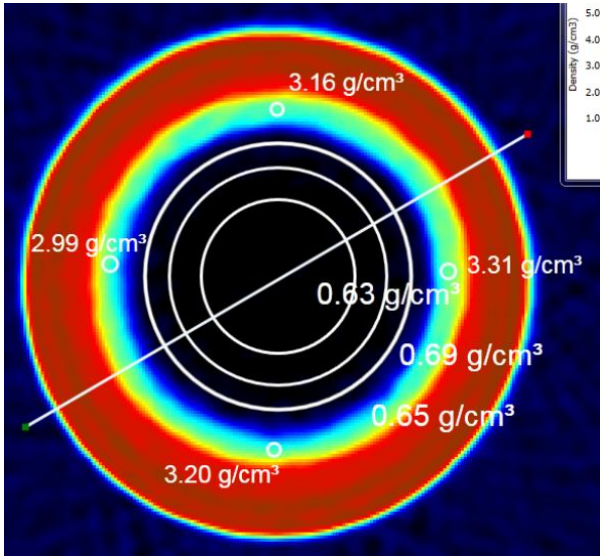


PLET

- Confirmed annular flow regime – water wet
- Unexpected internal build-up at PLET area

Flow Assurance Investigation

- Build-up concentric, density 3 – 5 g/cc
- Flowing Conditions: 4000 psi - 200°F
  - Rules out hydrate or paraffin build-up
- No asphaltene history
  - 1.2 g/cc
- No sand issues
  - 1.9 g/cc
- Medium Scaling Risk
  - 4.5 g/cc



Scale in Boarding Choke

- Choke maintenance in Jan 2015 revealed a thin build up
- Build-up tested & determined to be scale, **$BaSO_4$**
- Evaluated addition of scale inhibitor to chemical injection program

Sample ID		Mineral Phases Identified by XRD								
		Quartz (SiO_2)	K-feldspar($KAlSi_3O_8$)	Plagioclase ($NaAlSi_3O_8$)	Siderite ($FeCO_3$)	Calcite ($CaCO_3$)	Barite ($BaSO_4$)	Halite (NaCl)	Non-Diffractive Organic Solids	Total
NORM Scale Sample	10518	ND	ND	ND	ND	ND	96	1	3	100

Scale Inhibitor Implementation

- Increased coupon monitoring frequency
- Worked with chemical vendor to qualify inhibitor
- Scanning Electron Microscopy (SEM) used to evaluate particle size and growth

- **SEM testing (pre-inhibitor)**
  - Confirmed large particles with active growth
- **SEM testing (post-inhibitor)**
  - Indicates much smaller particles with no active growth

Summary

- Subsea CT scanning technology provided valuable results with no impact to production

- Obtaining value from subsea CT scanning requires thoughtful engineering / planning
  - "knowing where to look" + site prep time

Summary (con’t)

- Unexpected results & subsequent actions led to quick implementation of a successful inhibition program

- New wells will add value to Hess through extended flowline use

Acknowledgements

- Tracerco
- Nalco Champion
- Hess Integrity Management Team
- Hess Subsea Brownfield Team

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