Flexible Flowline Risers – Operational Experience

- Introduction & Background to Uisge Gorm Installation
- Riser Release Incident
- Recovery Back to Production Operations
- Follow up
- Summary
- Questions
General Arrangement Turret
The vessel was in operational state with P8 well shut in for integrity testing which had been carried out on the ESDV. Further tests were ongoing due to failure to meet test criteria.

P8 riser was at 80 Bar static pressure with the Production Wing Valve closed.

At 19.19 there was a rapid pressure release on the P8 flowline, followed by a gas alarm in the turret area. This caused a GPA & automatic level 2 shut-down of the plant.

All POB mustered & gas alarm reset 9 mins after the event started. ERT carried out a search of the turret area in BA, & confirmed the area was all clear of gas with no anomalies noted.
The emergency was stood down and further investigations revealed oily water in the turret can area where the risers terminate topsides.

The area was barriered off and access to the contaminated area restricted.

Closer investigation has revealed a possible riser failure on the P8 Flowline. All other process system remained shutdown.
Immediate Recovery Actions

- During further site inspection by crew there was noted to be water in the Turret Can (at the riser termination clamps)
- DSV mobilised to secure wellhead, & secure flowline to safeguard installation & environment
- Commenced investigations
Recovery Project

- **Who** - BW, Hess, MCS, Wellstream, NKT, Coflexip, Lloyds, the HSE pipeline authorities & DBERR.

- **What** – Objectives
  1. Find out what happened.
  2. Secure the failed riser
  3. Restart Uisge Gorm production operations

- **How** – physical examination
  - propose solutions
  - technical reviews & risk assessments (TRA’s)
  - Operational Risk Assessments (ORA’s)
  - Provide assurance onshore (BW, Hess, Authorities) & offshore that safe solutions achieved, and safe to restart & continue to operate.

- Commenced July 31st 2007, restarted production (P13) & WI end Sept 2007, and remaining wells by January 2008
Essentially riser failed. Following lengthy examination of flowline bore and I tube annular spaces the riser was found to have failed halfway down the I tube near the splash zone.

Credible failure scenarios considered by BW / MCS were:
1. Free corrosion in splash zone
2. H2S permeation through PVDF
3. Manufacturing defects
Clamp used to secure failed riser beneath the turret
Securing Clamp In Situ
Assurance - the road back to production

- Establish a process by which we can assure safe restart of production –
  1. Examination/Inspection/review of operating history
  2. Technical Risk Assessment/Assurance
  3. Operational Risk Assessments
  4. Review by ICP & Regulatory Bodies
TRA addressed the under noted items:

- Fatigue Failure
- H2S gas permeation
- Free Corrosion
- I tube Annulus Anomalies
- Topsides piping failures
- Riser Annular Gas Release
- Failure of the internal pressure Barrier
- Failure of the outer sheath
- ICP Review
Operational Risk Assessment

Issues considered (short & medium term)

- Failure mechanisms
- Operational excursions (e.g. Overpressure leading to H2S permeation, Over temperature etc.,)
- Gas permeability from inner bore to annular space of riser
- Pipeline maintenance
- Operational monitoring
- Chemical management
- MAPD and safety case QRA review
- WSE review
- Integrity management process review
Wellstream (WI/P13/P15)

Riser annulus vacuum tests carried out confirmed that WI & P13 were fully fit for service as per design. P15 had a very small anomaly (pinhole leak) as the vacuum test could not be fully executed.

Wellstream carried out further review of sensitivities of the fatigue analyses to assure BW of design life, and operating status on P15, which were positive. Both P13 & P15 were returned to service.
NKT (Fergus and Flora)
Flora riser was pronounced unsuitable for further service. Fergus F7 assurance evaluation was carried out with further review of the sensitivities associated with the fatigue analyses. F7 was returned to service.

Coflexip (Angus A14)
Fatigue analyses considered to be acceptable for continued service, as based on a flooded riser & little or no gas permeation. A14 riser was then used for Flora after sub sea intervention at Flora (open sub sea cross over).
Examples of MCS support

- MCS P15.ppt
Flexible Riser P15
Topside image of flexible riser P15
No visible major external sheath damage sourced near top of I-tube (typical image)
Wellstream Flexible Riser

- No annulus vent system installed
- 3 x 120° spaced annulus vent ports manufactured on the flexible riser end fitting
- Two sets of access ports are manufactured to each of the 3 vent ports (vertical and horizontal)
- Horizontal ports located just above I-tube top, all of which remain plugged since installation
- Vertical ports located on the end surface of the end fitting body.
P15 – Vacuum Test Results and Annulus Status Conclusions

- Vacuum Test completed twice with similar results
- Circa 60 litres extracted but only 20 litres N2 back-filled
- Results indicate a flooded annulus condition to LAT
- No gross external sheath damage identified at the plash zone, possibility to reuse riser based on fatigue calculations

No gross external sheath damage found [HOLD]
Flexible Riser P13
Topside image of flexible riser P13
No visible major external sheath damage sourced near top of I-tube (typical image)
P13 - End Fitting Vent Port Details

- Wellstream Flexible Riser
  - No annulus vent system installed
  - 3 x 120° spaced annulus vent ports manufactured on the flexible riser end fitting
  - Two sets of access ports are manufactured to each of the 3 vent ports (vertical and horizontal)
  - Horizontal ports located just above I-tube top, all of which remain plugged since installation
  - Vertical ports located on the end surface of the end fitting body.
Vacuum test results successful, which indicates the annulus status as non-flooded.

No external sheath damage identified.
Follow up

- As part of the ongoing operations planned maintenance routines were introduced to carry out periodic vacuum testing, and I tube annular inspections.
- Prior to the above pmr’s being carried out, the Uisge Gorm was decommissioned in 2008.
- As part of the riser removal process, the top part of the P8 failed riser was removed & sent for forensic examination. This has still to confirm the mode of failure.
Risers installed with a design life of 15 years, gave 11 years service.

Inspection regime, which was considered adequate in the 90’s by industry standards at the time was in reality not adequate due to a nil inspection within the I tube region.

Uisge Gorm returned to full production in January 2008 following a rigorous assurance process.

Uisge Gorm decommissioned mid 2008, & forensic examination has still to confirm the reason for the P8 riser failure.

QUESTIONS?