MCE Deepwater Development 2014

Anticipating Pipe-in-Pipe Loss of Integrity – Case Study for the Angolan Deepwater Network

8th April 2014

Olivier LANGEARD
Project Engineer
Flowline / Pipeline network description

- Deepwater: > 75% of oil daily production
- Mature blocks → integrity is critical
- About 2 618 km of flowlines / pipelines
- Rapid growth: +30% in next 5 years
- Nominal Diameters from 4” to 24”
WHY PIPELINE REPAIR?

- Significant network length and Mature fields
- One deepwater flowline rupture occurred on water injection system
- Synergy between Operators on each block
- Repair is part of Pipeline integrity management
- Reliability analyses identified values for Rapid Response System with Repair

→ Critical subject for Sonangol and Operators
WHICH REPAIR SYSTEM?

• In-situ deepwater repair of wet insulated rigid flowlines is feasible: Cut and replace with spool

• For Pipe-in-Pipe, how to address combined integrity challenge?
  ⇒ Restoring mechanical integrity
  ⇒ Restoring thermal integrity
1- Identification of damaged pipe
2- Pipe section cut
3- Pipe Preparation

4- Spool deployment
5- Connection
6- Reconnection at fallback position
PiP CHARACTERISATION

- Inner Diameter from 8” to 12”
- Outer diameter from 10” to 18”

- Field joints
  - Welded every 20/60 m
  - Welded every 500/2000 m or more
CONSEQUENCE OF PiP FAILURE

- Outer Pipe wall damage
  → annulus flooding (water ingress)

- Inner Pipe wall damage
  → annulus flooding (prod. release)

- Inner & Outer Pipes damage
  → water ingress /prod release to sea

→ Degradation of Thermal Insulation
CONSEQUENCE OF PiP FAILURE

- Welded field joints every 20/60 m

- Welded field joints every 500/2000 m or more
PIP REPAIR (SHORT ANNULUS)

→ Both sections of inner pipe and of flooded annulus is replaced by a spool

→ Repair connector insulated with flange cover

→ Specific coating removal tool for the PiP sleeve
PIP REPAIR PROCEDURE

Sleeve removal tool
(Modified End-preparation tool)

Cut with cutting tool next to bulkhead

Removing cut section together with pipe preparation tool

Grasping and seizing section of connector

600 mm

Connecting

Sleeve removal tool

Pictures by AS Connector

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→ Long section of annulus open to sea

→ Specific item on the annulus to recover partly the insulation performance

→ Discussion with repair connector Vendors

→ Design of Annulus Seal Connector
TYPICAL REPAIR SEQUENCE

1. Identify the damaged section.
2. Cut out the damaged section.
3. Prepare the end of the pipe for repair.
4. Insert the repair piece.
5. Secure the repair piece in place.
6. Apply the final sealant or adhesive.
7. Test the repaired section for integrity.

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RESTORATION OF THERMAL INSULATION

- Several Options
  - Pipe burying (2 m)
  - Rock dumping (less efficient than pipe burying)
  - PiP annulus flushing (gel – viscous fluid)
  - Deployment of outer shells (heavy operation)

→ no option allows to recover the initial thermal performance

→ Update of Operating Procedures and hydrate management plan is required
WAY FORWARD

• The repair of some PiP (short field joint section) is feasible restoring both mechanical and thermal integrity

• The repair of Other PiP (long annulus) do not allow recovering initial thermal performance:
  – More appropriate to adapt the design of the PiP
  – Include more water stops in the annulus to reduce the length of flooded sections in case of damage and allow future repair
  – Need an annulus seal connector
CONTACT INFORMATION

Olivier Langeard
Angola Deepwater Consortium
Langeard.o@doriseng.com

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