Reeled Mechanically Lined Pipe :

“A Cost Efficient Solution for the Transportation of Corrosive Fluids”

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What is MLP?

- **Advantages**
  - ✓ Cost
  - ✓ Schedule
  - ✓ Fatigue

**Host Carbon Steel Pipe**

**Clad Overlay**
(alloy 625)

**Liner** (stainless seam-welded pipe)
Grade selected to meet corrosion resistance need

MLP = Mechanically Lined Pipe

Pre Expansion

Interference stress

Post Expansion
Why Reeled MLP?

- **Reel-lay**
  - Efficient installation
  - Onshore fabrication & NDE

- **Challenge**
  - High installation strain
    - Risk of liner wrinkling

- **Qualified Solutions**
  - Reeling at *ambient* pressure with *increased* liner thickness
  - Reeling with *pressurised* bore and *nominal* liner thickness

Avoided when reeling is properly managed

Liner Wrinkles

Reeling

Reeling
Pressurised vs Ambient

Material & geometry dependent

- No change to std procedures
- Increase liner wt

- Standard liner wt
- Pressurisation procedures (time, cost)

Reeling Approach

Atmospheric Pressure

Pressurised

Pipe Size (OD”)

4” → 18”

In-line tees, intermediate operations
Qualification Ambient Reel- lay

- Inclusive of all steps of manufacturing
- Accounting for coating temperature exposure

FE models & Validation

2 Suppliers Industrialisation
- Quality Mgt.
- PFMECA
- Consistency
- Production run
- NDE process
- Internal spec.

Extensive Bending Test Program – Several Supplier/sizes/Materials
- From 6”OD to 14”OD
- Range of geometry and materials
  - X60-65 / 316L-825-625
- Range of suppliers
- Range of reel formers
- Uniform bending or local mismatch
- Up to 9 cycles (4.5 x reeling)
- Ultimate strain capacity
- Perpendicular bending axes

DnV Endorsement
Qualification of Pressurised Installation

- **Reeling Pressure**
  - Bending trials performed on 18” MLP joints
  - Pipes bent with reducing pressure until wrinkling
  - Mismatch bending condition simulated

- **Onshore Reeling & Offshore Installation**
  - Equipment & procedures developed
  - Full scale site integration trials
    - Onshore reeling
    - Offshore intervention
Fatigue Performance of Reeled MLP

- Nickel Alloy Welds
  - Slow crack growth
- Ground weld cap
- Counter-bored pipe ends
- Thicker liner (ambient)
1st Field Implementation – DGE Kodiak

Mississippi Canyon (GoM)

Devils Tower Truss Spar

Max. Water Depth: 5,610 ft (1,710 m)

42,000ft long tie-back (~12.8 km)

Max. Pressure: 6,000 psi (414 Bar)

Max. Temperature: 284°F (140°C)

OHTC: 0.8-BTU/hr.ft².°F (4.5 W/m².K)
1st Field Implementation – DGE Kodiak

- Onshore Welds (J): CMT(R+H), P-GMAW (fill), GTAW (cap)
- Offshore Welds (V): Manual GTAW
- NDT: RTR + AUT + 2D colour Scan + 3D Laser profile
1st Field Implementation – DGE Kodiak

December 2015 – Atmospheric Pressure MLP Reel-lay
Summary

- Increased demand for subsea transport of corrosive fluids
  - High interest in Bi-Metal Pipes & MLP in particular
- Reel-lay offers a cost efficient installation method
- Excellent fatigue performance in corrosive environment
- Two reel installation approaches qualified for MLP
  - Cost effective installation over full range of reelable MLP diameters
  - Comprehensive supplier industrialisation
- Ambient reeling successfully implemented on DGE Kodiak
Thank you