Emergency Pipeline Repair Solutions and Future Contingency Planning

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Part of the Actuant Corporation, Hydratight is a world leading engineering company who provide a range of specialist products and services to the Oil & Gas and Power Generation industries. Since 1901, our aim is to maximise safety and improve operational efficiency by supplying products and services that provide safe, reliable connections.

Products & services cover applications including:

- Torque & tension bolting
- Joint Integrity software & services
- In-situ pipe cutting, beveling, & prepping
- On-site, in-situ milling, line boring & grinding
- In-situ CNC thread capable 3D milling
- In-place leak sealing & valve testing
- Topside & Subsea Weldless Connections
- Customized engineering solutions
Objectives

• Discuss requirements for Pipeline Repair
• Share over 15 years of experience involving MORGRIP Pipeline Connectors
• Present the benefits of Contingency Planning using as Emergency Pipeline Repair System (EPRS) model
• Highlight some case studies & conclude
Requirement for Pipeline Repair

**Causes**
- Corrosion
- CP Failure
- Dropped objects
- Fishing activities
- Seabed structure
- Installation issues
- Anchor drag / drop
- Erosion / abrasion
- Internal blockage
- Operation Issues

**Outcomes**
- Holes
- Cracks
- Gouges
- Buckles
- Dents
- Severed Pipe

**Options**
- Containment
- Mechanical Connectors
- Replacement
- Hyperbaric Welding
- Surface Welding

**Examples**
- Clamp
- Sleeve Type
- Local Repair
- New Pipe

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Examples: Clamp, Sleeve Type, Local Repair, New Pipe

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Costs: $$$,$$$,$$$,$$$,
Mechanical Pipeline Connectors

DNV offer an independent standard (OS-F101 / RP-113) for Mechanical Connectors and their permanent use ...
MORGRIP Pipeline Connector

A highly developed mechanical connector satisfying approvals with simple premises:

• Proven equivalence to a weld in terms of safety, strength and reliability
• Suitable for any application where a weld would be the traditional solution
MORGRIP Connectors

- MORGRIP is a Hydratight core product
- Range of mechanical pipeline connectors
- 2400+ supplied worldwide over 20 years
- Repair, contingency, tie-in & construction
- Numerous Subsea & Topside applications
- 100% leak-free in-service record !!
MORGRIP Technology

Anatomy of a MORGRIP

Before Activation

After Activation

Axial Load / Tension

Metal/Graphite/Metal Seal

+ Torsion
Subsea Connectors

- Diver & Diverless installed
- Range of sizes to 42”
- Permanent connection
- Up to 30 years design life
- Standard products
- Bespoke solutions
- Infield experience
Typical Subsea Installation

**Typical Flange Adaptor Installation**
- Connectors deployed and stabbed onto pipeline(s), connectors activated.
- Spool piece positioned
- Spool piece connected to Morgrip

**Typical Coupling (Pipe-to-Pipe) Installation**
- Connectors are deployed either on spool or individually onto pipelines, fully positioned over
- Pipeline and spool aligned
- Connectors are centralised over join, activated and pressure tested
Typical Subsea Repairs

Diver Installed

Diverless
Pipeline Contingency Planning

Risk = Cost \times Probability

Threat \rightarrow Vulnerability \rightarrow Cost to Business

Risk Management through Contingency with Emergency Pipeline Repair Systems
Why Have EPRS?

- Risk reduction measure
- Reduce consequences of failure
- Minimize interruption to Production
- Limits escalations in Insurance
- Widespread consequences due to interconnectivity of multiple Assets
- Repair equipment on long lead times

Being REACTIVE is significantly more expensive than being PROACTIVE!
Pipeline Connector EPRS

- Avoid treating requirements in isolation
- Draw on suppliers experience & expertise
- As much about being driven by supplier as the end users
- Highlight similarities between Asset owners
- Formation of Club(s) / collective membership
- Methods can always be improved – even after EPRS is established
Operators & Pipelines

- Upfront application data is key to assessing and establishing widest options
- Key pipe data is not always easily available
- Understanding complete contingency methodology and actual requirements
- Working with Installation Contractor upfront achieves more robust EPRS coverage
EPRS Assessment

- Engineering assessment for multiple pipe coverage has significant influences on reducing number of components
- Multiple technical review cycles with all members is key to highlight drivers for optimised solutions
- Designing for Common Installation equipment offers CAPEX savings
## EPRS Optimization

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**Example EPRS Pipeline Data Set**

| | | | | |
EPRS Options

Connector Format can reduce overall price.

Common Installation parts across sizes can save typically 35%

Level of completeness can significantly influence actual CAPEX required

Don’t always need fully complete connectors!
EPRS Implementation

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<tr>
<th>Category</th>
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<th>B</th>
<th>C</th>
<th>D</th>
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<tr>
<td>Pipe Size Range</td>
<td>8” – 16” #300lb</td>
<td>16” – 24” #600lb</td>
<td>24” – 28” #900lb</td>
<td>30 – 34” #900lb</td>
<td>36” (complete)</td>
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<td>Delivery Commitment</td>
<td>15 days</td>
<td>20 days</td>
<td>25 days</td>
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- Low CAPEX cost ‘membership’ fee
- Low annual OPEX ‘subscription’ rate
- Tailored contingency solutions
- Guaranteed access to high quality pipeline repair equipment
- Short lead times for supply of connectors – within mobilisation times of owners
EPRS Management

- EPRS does not end once equipment is produced and put into Storage ...
- Maintaining equipment, personnel and documentation is key to ensure smooth call off and timely repair
- Periodic ‘Dry Runs’ of call off are very effective to ensure competencies are maintained
Summary of EPRS

- Providing short lead time MORGRIP repairs as contingency for pipeline failure
- Low cost membership & subscription
- Eliminating major annual CAPEX or OPEX
- Bespoke contingency solutions
- Guaranteed access to quality equipment
- Significantly reduced repair lead times
Case Study – Diverless EPRS

- Part of STATOIL PRS Deepwater Contingency to cover 8in to 30in for up to 600m W/D
- Diverless Pipe to Pipe Connectors - 3in, 10in, 12in, 16in, 20in, 28in and 30in coverage
- Fully complete, utilising shared components across all sizes – offering considerable savings
- Maximum 18 day call off for mobilization
- Maintenance and storage contract including personnel competencies for installation
- Frame agreement for future manufacturing
Case Study - Snorre Vigdis

- Pigging problem causes damage to 12in Snorre Vigdis pipeline in 305m W/D
- STATOIL PRS contingency system employed
- MORGRIP configured, assembled, FAT tested and mobilized in Norway within 20 days
- Integrated & tested into installation frame onshore and offshore prior to deployment
- Repair completed in 24 hours:
  - Coupling deployed in installation frame
  - Pipe manipulation & pipe stab in
  - Coupling activation
  - Externally pressure tested
  - Installation frame recovered
Case Study – Israel NG Line

- INGL operate 30” pipeline offshore supplying <40% of national electricity production
- Anchor damage to pipeline in 2005 repaired with 2 off MORGRIP Flange Adaptors
- Diver installed with Hydratight supervision in less than 24 hrs
- INGL have complete EPRS solution including tooling and manpower to mobilize locally
Case Study – Topside Project

Turnkey Installation & EPRS Stocking for PETROBRAS:

- Asset survey conducted
- Pipe Data assessment to maximise coverage using minimal connectors
- Supplied 160 off connectors ranging from 3in to 20in to all pipelines and cover 3 FPSO / Platforms
- Train local workforce on installation
- Pipe prep, installation, testing and maintenance + full joint management
Summary & Conclusion

• Mechanical connectors provide a viable permanent alternative to welded pipeline repair solutions
• Suppliers have an obligation to offer high level assessment to help drive CAPEX down
• Connectors can be easily adapted to offer more EPRS supply options without deviating from proven formats
• ‘Dry runs’ have proved to be highly valuable to ensure procedures and competencies are maintained
• Future application (especially for topside installations) calls for full Joint Integrity Management ...
Thank You ... Any Questions?

For further information please visit ... [www.hydratight.com](http://www.hydratight.com)