Survey Operations – Pipeline Inspection

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Agenda

Why Inspect?
Definition of a Pipeline
Types of Survey
Positioning
Data Processing
The Future
Conclusions
Why Inspect?

Legislation – Statutory Instruments
Cost of Failure
Why Inspect?

- **Pipelines Safety Regulations 1996**
  
  - To apply a common approach to the control of risks from pipelines, both on and offshore
  
  - To replace existing pipeline safety regimes with a single goal-setting group of regulations reflecting the general policy of the HASAWA 1974

“The operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair.”
Why Inspect?

- Regulation 13 addresses pipeline maintenance and inspection requirements

  “The pipeline operator needs to consider both how and when the pipeline should be surveyed and examined to validate and maintain it is in a safe condition.”
Why Inspect?

- Cost of Failure
  - Environmental
  - Loss of Production
  - Repair / Replacement cost
Pipeline Definition

Riser / Spoolpiece
Sealine
Landfall
Pipeline Definition

- The Riser – connects production facility to subsea field
- The Spoolpiece – connects riser to sealine
- The Sealine – main export pipeline
- The Landfall – connects sealine and landfall terminal
Pipeline Definition - Riser/Spoolpiece

- Most vulnerable in Splash Zone and can degrade rapidly due to
  - Instability
  - Current
  - Wave Action
  - Corrosion - electrical & chemical
  - Movement
  - Impact - Collision

- Inspection options
  - Above sea level - RATS
  - Splash Zone - RATS / divers
  - Subsea - DP Vessel & ROVs
  - Subsea - Platform based ROVs
Pipeline Definition - Sealine

North Sea
- 20,000+km “pipeline”
- Pipelines: gas & oil & water
- Umbilicals - electric, hydraulic, chemical elements.
- Cables - electrical & fibre optic
- Multifunction pipeline bundles

At risk from
- Anchors & Trawl gear
- Instability
- Current & Wave Action
- Corrosion - electrical & chemical
- Buckling (upheaval & lateral)
- Munitions

Main Types of Inspection
- GI = Acoustic sensors
- GVI = Visual sensors
Pipeline Definition - Landfall

The part of the export pipeline in the inshore zone
- TOB to @ 3km offshore.
- Through the inter-tidal zone.
- Buried, rock-dumped or in conduit.
- Protected

At Risk From:
- Anchors & Trawl gear
- Munitions
- Very Strong Currents
- Wave Action - to seabed
- Erosion / Deposition
- Beach activities
- Corrosion - chemical & electrical

Main types of Inspection
Conventional Inshore and Land Survey Methods
Types of Survey

- General Imaging (Acoustic)
- General Visual Inspection
- Landfall
- RATS
- Diver
# Types of Survey

<table>
<thead>
<tr>
<th>Inspection</th>
<th>Survey Platform</th>
<th>Type / Method</th>
<th>Component</th>
<th>Notes / Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATS</td>
<td>Platform based</td>
<td>Visual - cameras, NDT techniques</td>
<td>Riser</td>
<td>Down to splash zone, Weather</td>
</tr>
<tr>
<td>Diver</td>
<td>Platform or DP vessel based</td>
<td>Visual - cameras, NDT techniques</td>
<td>Riser</td>
<td>Depth, Current, Weather, Sea state, HSE</td>
</tr>
<tr>
<td>Landfall GI</td>
<td>Inshore survey vessel</td>
<td>Hull mounted, Acoustic, CP snake</td>
<td>Pipelines</td>
<td>Inshore only, Weather, tides, Seastate @ 1m, Fishing gear</td>
</tr>
<tr>
<td>Structural GVI</td>
<td>Oil platform or DP survey vessel</td>
<td>Visual – cameras, NDT techniques, FMD</td>
<td>Legs, Structural members, Risers</td>
<td>Weather, Sea state @ 2m, Current, Visibility</td>
</tr>
<tr>
<td>Pipeline GI</td>
<td>Survey vessel, ROTV</td>
<td>Towed SSS, Acoustic</td>
<td>Pipelines</td>
<td>Seafloor structures only, Cannot stop, Current restrictions, Seastate @ 2m</td>
</tr>
<tr>
<td>Pipeline GVI</td>
<td>DP survey vessel, WROV</td>
<td>DP follow sub, Visual – cameras, CP</td>
<td>Riser</td>
<td>Current restrictions, Visibility, Seastate @ 4.5 – 5 m</td>
</tr>
</tbody>
</table>
Types of Survey – General Imaging (GI)

Sensors

- Sidescan Sonar
- Multibeam Echosounder
- Single Beam Echosounder
- Sub-Bottom Profiler
- Magnetometer

Sensor Platforms

- DP Vessel
- Towfish
- ROTV
- AUV
Types of Survey – GI

Side Scan Sonar

Typical Pipeline Fingerprints

A
Pipe in contact with the seabed

B
Pipe clearly spanning

C
Pipe in area of shallow scour

D
Pipe in suspension in scour trench

E
Pipe with seabed buildup away from sonar

F
Pipe with seabed buildup towards sonar
Types of Survey – GI

DATA EXAMPLE 8

DATA EXAMPLE 10

DATA EXAMPLE 11

DATA EXAMPLE 12

Hard Debris

Soft Debris

Fishing Gear

Penetrate
Exposure

Linear Debris
Types of Survey - GI

• Upheaval Buckling
Types of Survey – GI

Multibeam Bathymetry

Point soundings used to create DTM

Shaded Relief and or Contours created from DTM
Types of Survey – GVI

Typical Focus Areas

- Lay comfort
- Freespans
- Pipeline damage
- Debris
- Anodes and cathodic protection
- Seabed features and targets
- Pipeline and cable crossings
- Lateral movement
Types of Survey – GVI

**Sensors**

- Cameras
- Depth
- Altitude
- Cross Profilers
- Pipetrackers
- MBE Bathymetry
- SSS
- Cathodic Protection
- Temperature
Types of Survey – GVI

- Cross Profilers
Types of Survey – GVI

- Dual Cross Profilers
- ROV High Fly
- ROV Low Fly
Types of Survey – GVI

- GVI of Upheaval Buckle
- Estimated height 4m
- Bottom left image taken from ROV sitting on seabed
Types of Survey – GVI

UXO

• Air dropped mine
• Ordnance adjacent to pipeline
Types of Survey – GVI

• Examples of damage to pipelines
Types of Survey – Landfall

Sensors and Methods

• MBES
• Sidescan
• Sub bottom profiler
• Trailing Wire CP
• RTK GPS
• Small ROV
• Divers
Types of Survey – Risers and spools

Sensors and Methods

- Rope Access Teams above splashzone
- Cameras on poles / divers in splash zone
- Eyeball ROV to the seabed - Vessel or platform deployed
Positioning

Surface
Sub Surface
Timing
Positioning

Surface
- GNSS – RTCM, PPP
- RTK
- INS – IMU/Heading
- Range bearing systems

Sub Surface
- USBL
- INS
- IMU
- Doppler Log
- Pressure Sensor
- CTD/SVP
Data Processing

- Navigation
- Sensor Data
- Pipeline Events
- Data Formatting/Deliverables
- QC
- Data Storage
Data Processing

- Process Navigation – remove outliers, run filter
- Process Depth/Pipetracker – apply tidal correction
- Clean Cross Profiler/MBE data
- Create 5 point files
- Review and Event Video
- SSS Target Interpretation
- Create Charts/Report
- Format data for client specified deliverable
- Data management
Data Processing
Data Processing

What the client wants

- Anomalies threatening integrity of asset - immediate
- Significant features - 24hrs
- All observable anomalies - 7 days
- Survey report and all events - 4 weeks
Data Processing

Integrity Management:
- Pipeline Reporting Inspection
- System Multimedia

- Historical data allows trend analysis
- Drill down to detail
- Plan future Inspections
- Plan remedial works
Anomalies

Identify Pipeline features that:

- Fall outside given criteria
- Cause concern for the integrity of the pipe
The Future

Video
AIV
GIS
The Future

Video
- HD
  - Improved resolution & image/colour definition
- 3D
  - Depth of field
- LED Lighting
  - Shock resistant & longer life

Challenge
- Data volume
The Future - AIV

- Provides a cost-effective, low-risk inspection system to aid field survey and integrity management and intervention activities
- Operates directly from a host facility e.g. FPSO, platform or infield support vessels
- The AIV has no tether which enhances vehicle manoeuvrability and the capability to access confined spaces
- The AIV carries an array of navigation tools and sensors that are powered by its own onboard battery power source.
The Future

GIS

- Slow adoption in the Oil Industry
- Can be delivered across the internet
- Repository for all pipeline data with a spatial component
Pipeline inspection is a mature business
Methodologies for the use of the current tools are well established
New technology continues to deliver cost and efficiency benefits along with implementation challenges
The client in the office is getting closer and closer to the data
seabed-to-surface

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