Life Extension Technology for Mature Offshore Pipelines
&
New Cathodic Protection Performance Monitoring Strategies

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Presentation Outline

1. Strategy Basics
2. Designing Life Extension Systems
3. Hardware
4. Emerging Tools & Technologies
5. Summary
Strategy *(The Gas (Petrol) Tank Strategy)*

- Management of CP system resources on offshore pipelines is analogous to maintaining the fuel in your car’s gas (petrol) tank.
Strategy *(The Gas (Petrol) Tank Strategy)*

- You should not risk running out of gas unless you are on your way to:
  1. A car dealership to trade the vehicle
  2. A car rental return office

- If you plan to retain ownership and ongoing benefit from the pipeline:
  - Do not let the CP deplete
Basic’s of Petrol (Gas) Management

1. Use Your Fuel Gage (Gauge) Wisely.
   – Tells You What’s Going On
   – Use intelligent survey methods

2. NEVER Run Out of Gas.
   – Can Cause Irreparable Damage
   – Get CP life extension strategy into IRM program

3. DON’T Let the Tank Get Too Low.
   – Reduces refueling options and can cause damage
   – Act while existing CP has at least 15% of life remaining

4. Keep Adequate Fuel in Tank
   – Maintain tank level between ¼ - Full
   – Get CP retrofit into IRM budget, complete in stages
Designing the Repair

• CP Anode Replacement is a REPAIR and should be treated as such:
  – Increased surveillance and performance monitoring post installation
  – Conservative design criteria
  – Build in redundancy
Designing the Repair – Key Considerations

1. Achieve a design that satisfies regulators in the absence of any recognized industry code
2. Optimize anode spacing to reduce number of points of access to the pipeline
3. Integrate monitoring and surveillance aids to verify system performance
4. Understand geotechnical and met ocean variables and select appropriate hardware
5. Ensure that procedures consider diver & pipeline safety where appropriate
Hardware

• Offshore Pipeline CP Retrofit Systems have three Sub-components:
  1. Anode Arrays
  2. Contact Clamps and Tie-Backs
  3. Monitoring Equipment
Anode Arrays – Basic Requirements

• Must be stable on the seabed or the pipeline.
• Must not present subsea hazard, fishing, recreation etc.
• Must provide required CP coverage and life expectations.
• Must be safe to lift transport and install offshore.
Anode Pods

- Use on Deepwater or Exclusion Zone projects only
- Provide for:
  - Easy install
  - Good platform for monitoring
  - Excellent CP efficiency with water zone anodes
Rigid Anode Sleds

• Use for general applications sub-bottom, stable seabed.

• Provide for:
  – Low cost
  – Require separate monitoring platform
  – Need jetting or sandbagging
Flexible Anode Mats

• Use in shallow water, bottom laid, unstable seabed conditions:

• Provide for:
  – Flexible design
  – Integrated monitoring
  – Build on site
  – Simple installation
Pipeline Mount Anodes

• Use for local repairs, deepwater ROV repairs, hot spot protection:

• Provide for:
  – Local ROV installable CP supplement
  – Simple installation
  – Replaces missing bracelet anodes

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Contact Clamps & Tie Backs – Basic Requirements

• Provide cost effective, cold, reliable long term electromechanical connection to the pipeline for purposes of:
  – Anode connection
  – Condition monitoring
• Install with minimum pipeline excavation.
• Install with ROV if necessary.
• Must not damage the pipeline.
• Must allow subsequent anode attachment.
For Anode Attachment

- Select correct clamp set up for:
  - Thin film coatings
    - Low creep, hard springs, volcano tip
  - CWC penetration
    - High creep, soft springs, cutting tip
  - Thick films > 6 mm
    - High creep, very soft springs, drift awl ti
For Instrument / Test Point Service

- Use same set up on springs and tips, in addition the following can be added:
  - Stab plate(s) pig markers
  - Reference electrodes
  - Test leads
  - Readouts
  - Net guard
Monitors – Basic Requirements

• Long term reliability and stability.
• Ease of relocation.
• Readouts suitable for Diver / ROV / AUV.
• Retrofittable
• Redundantly backed up
For Bottom Laid Pipelines

- Simple Stab Plate or comparator plate
  - Can also be used to position MFL pigs
  - Use standard ROV survey tools
  - Visual on comparator plate can aid AUV evaluations
For Buried Pipelines

• Mat based stab plates:
  – Integral in Flex Mat anode systems
  – Can be interrogated by Diver or ROV
  – Easy to relocate with low cost magnetometers
  – Good for shallow water
Light Powered Readouts

• Rigid or Buoyant:
  – Can be interrogated with AUV or ROV

• Good for Buried or Unburied Pipelines:
  – Can display visual voltage values from variety of fixed sensors
New Tools – Emerging Technologies

- Providing interface to in-line inspection tools on outside of pipeline.
  - Position
  - Data transfer
- CPCM tool performance is enhanced with retrofitted CP systems.
  - Baker tool can locate and quantify retrofitted anode performance on candidate pipelines.
- AUV’s can now add CP surveillance to their list of tasks.
  - Visual
  - Short range data exchange
Cathodic Protection Current Mapping (CPCM)

- New tool from Baker PMG
- Good on piggable liquid lines
- Measures CP return currents flowing in pipe wall
Tool Run on 12” Offshore Oil Pipeline (GOM) Post Retrofit

Caliper Data

Retrosled Anode Sled draining 0.82A from U/S and 0.23A from D/S Total Amperage = 1.05A

Current Flow

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Summary

• Develop IRM integrated CP life extension strategy on pipelines (and other structures).
• Design conservatively
• Select appropriate and proven hardware
• Leverage life extension attendance to improve life cycle monitoring capabilities.
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