

Improvements in Offshore Cathodic Protection Retrofits



M. Edgar Lewis

DEEPWATER



moe

Offshore CP Retrofit Market

- Global offshore infrastructure
 - ~8,200 platforms
 - ~144,000 km of pipelines
- 35% of this infrastructure is 20 years and older
- Less than 5% of this infrastructure is being retrofitted every year
- Within 10 years, almost two thirds of this infrastructure will be 20 years and older
- We have some catching up to do

DEEPWATER



moe

New Construction vs Retrofit



- Bracelet Anodes
 - High resistance
 - Low utilization factor
 - High manufacturing cost
 - Poor “throwing power”
 - Can damage pipe coating
 - Anode attachment
 - Pipe laying
 - Can become detached

DEEPWATER



moe

New Construction vs Retrofit



- Platform Anodes
 - Stand-off distance is not optimized
 - Anode utilization is reduced
 - Additional anodes are required to offset these constraints

DEEPWATER



moe

Retrofit Version 1.0 - No Improvement



Dual Clamp-On Anode System

DEEPWATER



moe

New Methodology for CP Retrofits

- Do what they do onshore
 - Place the anodes remote or semi-remote
 - Make the anodes as long (low resistance) as we can

DEEPWATER



moe

CP Retrofit Design Considerations

- Usually some degree of polarization remaining
- Design life extension may be limited, hence not necessary to optimize protective potential levels
- Able to measure the existing polarization characteristics (CD vs potential)
- Able to monitor anode and cathode responses during retrofit, and adjust, if necessary

DEEPWATER



moe

CP Retrofit Strategies - Pipeline

- Get the anodes off the pipeline
- Minimize the number of locations
- Select locations with minimal depth of cover
- Minimize bottom time requirements at each location
- On deeper projects, use ROV versus saturation divers
- Maintain flexibility to adjust the retrofit plan as you go
- Don't overlook what the pipeline is connected to

DEEPWATER



moe

CP Retrofit Strategies - Platform

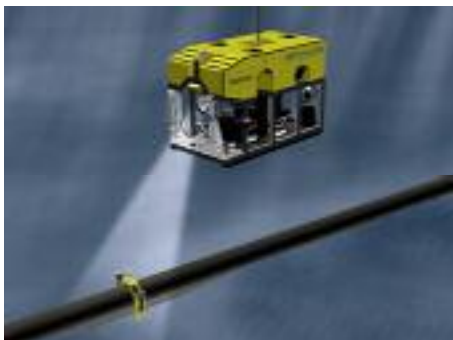
- Get the anodes off the jacket
- Diver safety
- On deeper projects, use ROV versus saturation divers
- Minimize the number of anode installations
- Minimize the amount of marine growth removal
- Maintain flexibility to adjust the retrofit plan as you go
- Don't overlook what is connected to the platform

DEEPWATER



moe

CP Design - Pipelines



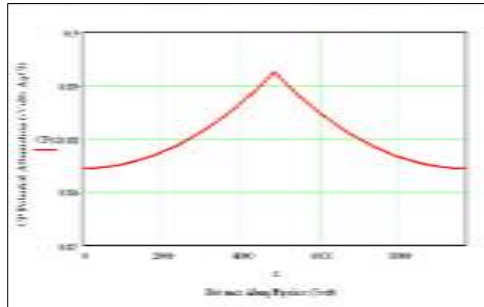
- Required information
 - Length/diameter
 - Pipe wall thickness
 - Operating temperature
 - Coating type/thickness
 - Weight coating thickness
 - Pipeline tie-ins
 - Design life
 - Minimum design potential
- Nice to have
 - CP data
 - Burial depth
 - Old anode spacing

DEEPWATER



moe

CP Design - Pipelines



- Attenuation Modeling
 - Output
 - CP potential along the pipeline
 - Anode mass required
 - CP current
 - Determine optimal CP system installation site(s)
 - Should comply with DNV RP-F103, NACE & ISO design standards

DEEPWATER



moe

CP Design - Platform



- Required information
 - Number/diameter of legs/piles/conductors
 - Water depth
 - Horizontal framing elevations
 - Diameter of lowest elevation's VDs (for clamp fit)
- Nice to have
 - As-built or inspection drawings
 - CP data
 - Subsea inspection data
 - Platform crane capacity

DEEPWATER



moe

Anode Pod



DEEPWATER



moe

Anode Pod – Booster Anodes

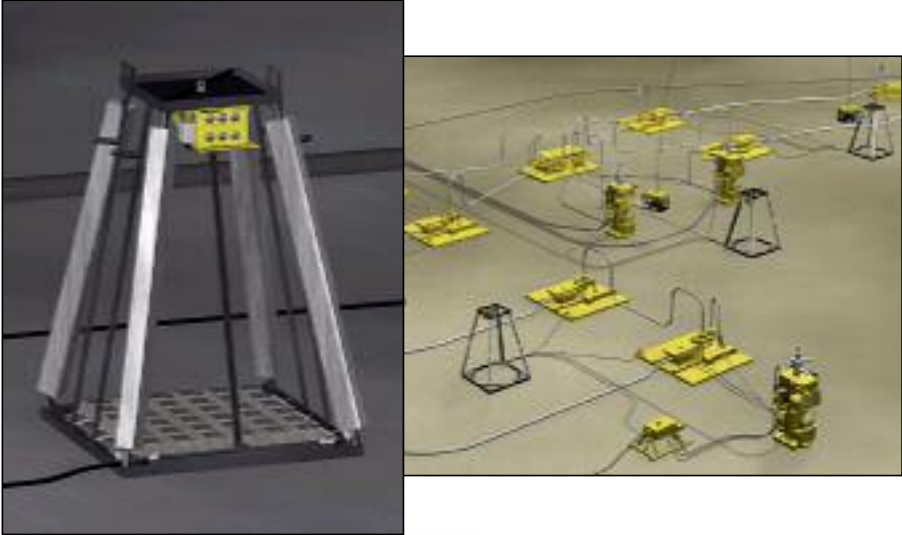


DEEPWATER



moe

Anode Pod (Intelligent)



DEEPWATER



moe

Anode Pod (Intelligent)



DEEPWATER



moe

Anode Sled

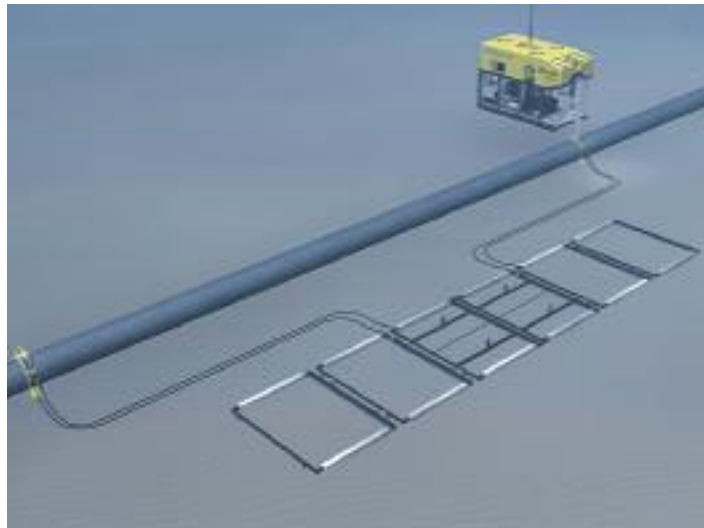


DEEPWATER



moe

Anode Sled (Expanded)

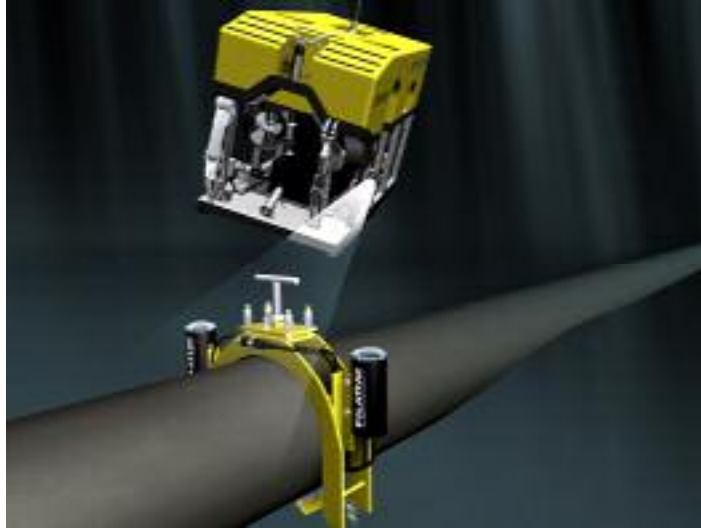


DEEPWATER



moe

Clamping System



DEEPWATER



moe

Clamping System



DEEPWATER



moe

Clamping System

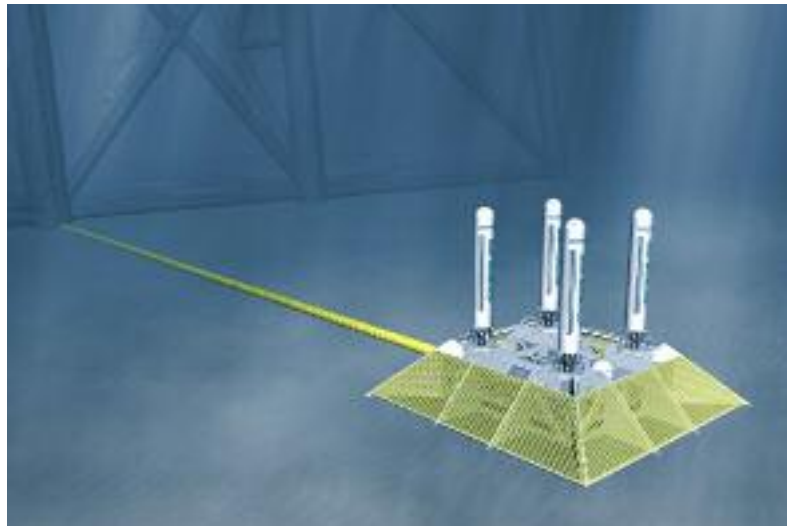


DEEPWATER



moe

Impressed Current Remote Sled

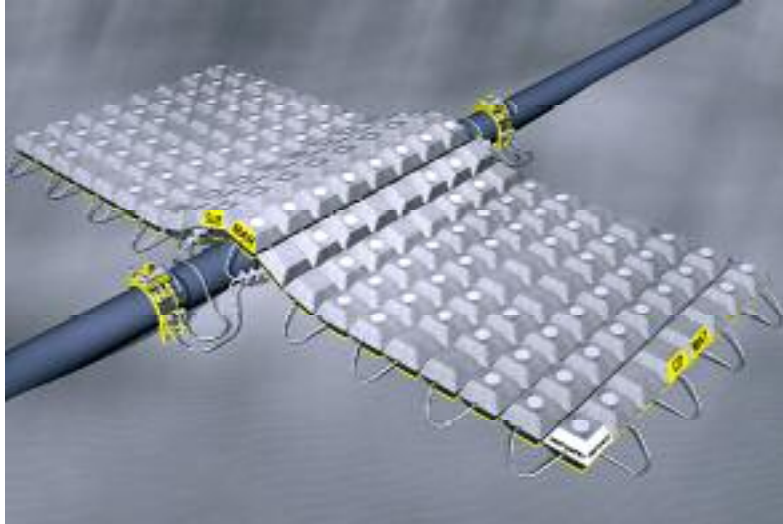


DEEPWATER



moe

Anode Mat

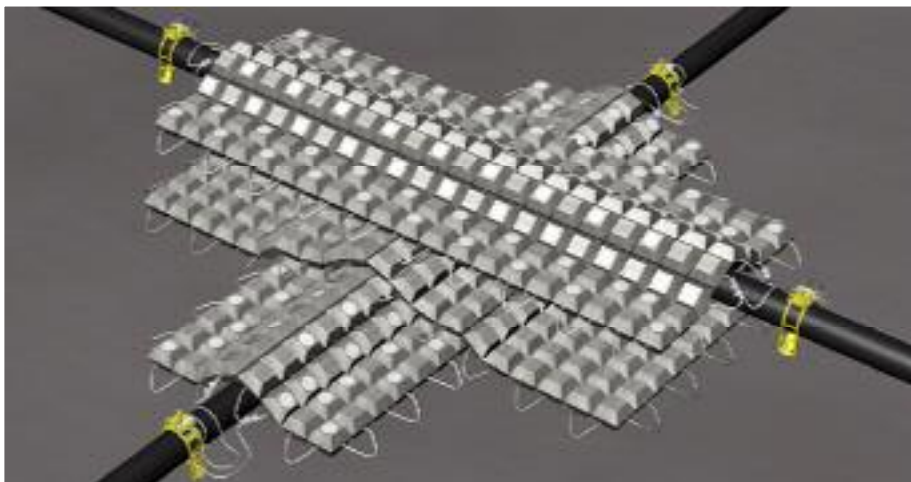


DEEPWATER



moe

Anode Mat



DEEPWATER



moe

Link Anode System

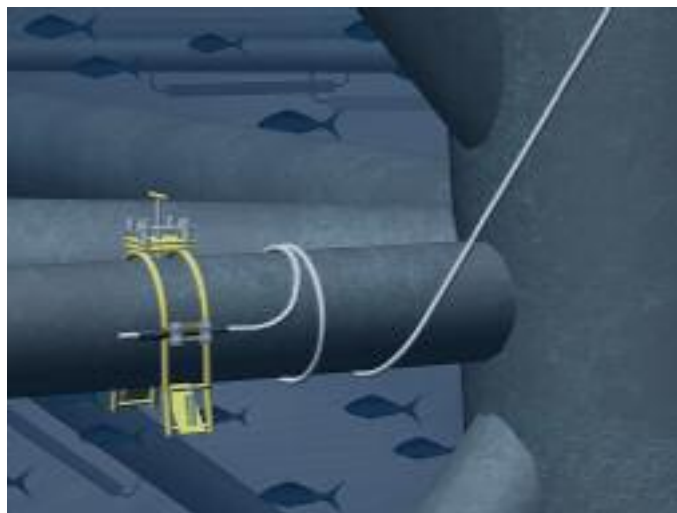


DEEPWATER



mpe

CP Retrofit Monitoring



DEEPWATER



mpe

Cost Comparisons

- Anode Pod
 - 50% - 70% of the cost of dual clamp-on anodes
- ICCP
 - 30% - 50% of the cost of dual clamp-on anodes
- Anode Sled
 - < 50% of the cost of “conventional” sleds (sledges)

DEEPWATER



moe

Thank You

