

### Agenda

- Market Drivers for AUV
- Introducing iCP
  - (integrated Cathodic Protection inspection system)
- iCP Results

### **AUV Market Driver**



### Limitations of Traditional FG Systems



- Significant attenuation v distance
- Horizonal offset errors
- OK for use on ROV where surface to probe distance is minimal but no use in AUV survey configuration

### Reducing OPEX

AUV pipeline inspection reduces OPEX in comparison to historic ROV pipeline inspection



OFG iCP enables AUV to become a viable alternative to ROV for pipeline inspection



OFG ISES DOF Subsea

### **O&G AUV Timeline**

1999: AUV development in O&G

2014: Single pass pipeline Inspection

2018: Pipeline Inspection including non-contact iCP



Cost effective integrity management

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# Introducing OFG iCP

### iCP Technology Pathway

- System developed and operated for seafloor mineral (SMS) mapping by OFG
- System modified for O&G subsea CP application in co-operation with ISES
- In-field system trials in early 2018 over operational pipeline
- 2019 1st Commercial project with DOF



### iCP Capability

Accurately report field gradient measurements relative to pipe

Current flow through the pipe can then be mapped

Determines:

- Level of cathodic protection
- Activity of anodes -> estimate of remaining anode life
- Leakage currents in pipe indicating pipe damage







## OFG iCP First Commercial Project

### DOF AUV Updated Payload

#### OFG/ISES iCP

- OFG Magnetometer
- CH4 (Methane Sniffer)
- Cathx Laser
- 4K Cathx Colour Camera



### iCP Results

- Variations of approximately 0.02µV/cm were reliably and repeatably detected
- Vastly improved sensitivity in comparison to ROV FG systems (1µV/cm ROV)
- FG measured for all anodes locations verified against historic ROV video survey
- Instances of low current output verified as anode anomalies – historic data



### **CP** Reference Stabs

The OFG AUV iCP survey allows surveys to be conducted with **minimal or no requirement** for time-consuming potential contacts. Consider the following scenarios:

- Potential measurements from previous surveys would easily be able to confirm the status quo, based on the system's ability to accurately determine the magnitude and direction of the electric fields.
- If unusual or anomalous activity is detected, then a small inspection class vehicle could be deployed immediately or at a later date.



### Monitoring

- As the cathodic protection system ages, anode activity and wastage increases.
- These trends can easily be identified and tracked using the OFG AUV iCP system.
- Remedial action can then be planned well in advance.



### iCP Benefits

Measuring the electrical field (field gradient uV/cm ) around a pipeline with the sensitivity of the AUV iCP system also allows:

-	Current density along the pipeline	-	Disconnected or passivated anodes.
-	Anode current output	-	Identification of anomalies
-	Anode activity	-	Identification of areas of active coating damage
-	Estimation of remaining life of the anodes	-	Current drain (e.g. to platform, well head)
-	Identification of location, direction and magnitude of current flow.	-	Areas exhibiting higher than expected current flow.



Position Lightly Active Anodes Mid-line

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**Current Drain to Structure** 





### iCP Summary

- 1. Accurately detect and quantify Field Gradient (FG) and current flow along a pipeline route at significantly higher speeds than historic ROV survey.
- 2. Detect & quantify pipeline electrical fields to an unprecedented level (variations of ~0.02uV/cm) from which currents (anode and damaged or areas of current drain) can be calculated.
- 3. Signal accuracy is not reduced by either vertical or horizontal standoff distances between the AUV survey position and the pipeline.
- 4. The system can gather **multiple data sets from other sensors simultaneously** without degrading the received signals.
- 5. The OFG iCP system can add **significant value in efficiency and cost savings** when used as part of an **integrated pipeline inspection management strategy**



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Thank You!

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