Wireless Sensor Monitoring of Cathodic Protection Solutions

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• Introduction to Proserv
• Cathodic Protection and Monitoring Methods
• Proserv’s Acoustic Digital Spread Spectrum (ADS²) Technology
• Case Study: NASCoM on Leman Alpha – Challenges and Successes
Proserv is the fresh alternative in global energy services.

We are a technology-driven company providing **products, services and bespoke solutions** to clients across the drilling, production and decommissioning market sectors.

Combining technical ingenuity with design, engineering, manufacturing and field services expertise, we support clients throughout the lifecycle of their assets with a focus on **maximising operational performance** and **efficiency**.
Global Operations, Local Delivery

**United Kingdom**
Aberdeen, Coatbridge, Great Yarmouth, Sites: 6

**North & South America**
Houston & Louisiana, Sites: 3

**Middle East & Africa**
Dubai, Abu Dhabi, Saudi Arabia, Sites: 3

**Scandinavia**
Stavanger & Trondheim, Sites: 2

**Asia Pacific**
India, Indonesia, Singapore, Malaysia & Australia, Sites: 5

**Emerging Markets**
Qatar & Nigeria, Sites: 2
Life of Field Services

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![Surface Production Image](image1.png)
![Subsea Production Image](image2.png)
![Drilling Image](image3.png)
![Decommissioning Image](image4.png)
![Renewables Image](image5.png)
Cathodic Protection
The Need for Corrosion Protection

Scale of North Sea:

- Approximately **600 platforms** (The Guardian)
- **45,000 km** pipelines (Oil & Gas UK)
- Approximately **1,500 turbines** (321 under construction - Wikipedia)
- Wellheads, templates, manifolds
Corrosion Protection Methods

Painting
- Prevent contact with seawater
- Pre-deployment, additional protection required if damaged

Galvanic coating
- Prevent contact with seawater, provide protection if a break occurs
- Pre-deployment, additional protection required if damaged
Corrosion Protection Methods

**Bolt-on sacrificial anodes / anode sleds**
- Provide **cathodic protection** to structure
- **Periodic replacement** to maintain protection

**Impressed current**
- Long term cathodic protection using **generated electrical current**

**Periodic replacement**

It is possible to have too much protection!
Corrosion Monitoring Methods

- **Reference electrode**
  - Zn + AgCl

- **Probe structure using divers/ROV**
  - Periodic surveys, expense of personnel/ROV, repeatability of measurement

- **Fix to structure and cable back to surface**
  - Cable protection / integrity, installation complexity, more frequent and repeatable measurements

- **Fix to structure and use wireless communication**
  - Increased cost of sensor node, lower cost of installation, more frequent and repeatable measurements

- **Field gradient sensor**
  - Designed for ROV ‘contactless’ survey
  - Periodic survey, expense of ROV deployment
Subsea wireless communication

- RF, Optical, Acoustic

**RF**
- Advantage: communication through splash zone, medium data rate
- Disadvantage: range approx. 10m, antenna size

**Optical**
- Advantage: high data rate, range approx. 100m
- Disadvantage: limited by water visibility, saturated by daylight in shallow water

**Acoustic**
- Advantage: range >1,000m
- Disadvantage: no comms through splash zone, low data rate (however data is slow changing)
Our core subsea communications technology is ADS²

Acoustic Digital Spread Spectrum
Advantages over traditional and high frequency broadband systems:
• Extremely robust signalling
• Longer ranges
• No interference

Proven on critical military and oil and gas projects worldwide
Case Study:
Leman Alpha
Case Study: Leman A Installation

Case Study
Location: Shell Leman Alpha, North Sea

Client: Deepwater EU
Impressed Current
Cathodic Protection +
Acoustic Remote Monitoring

Multiple Monitoring Locations

Monitoring multiple CP sensors around platform jackets

Additional monitoring of an SSIV (200m south)
The scenario

- Long term deployment, avoid ROV or diver intervention
- Ensure distribution of protection provided across the structure
- Wireless communication to avoid permanently installing cables through splash zone – expense of deployment, longevity of cables

Challenges

- Ensuring communication range and reliability
- Battery life to make the installation viable (no ROV intervention)
- Hardware suitable for > five years deployment (resist corrosion)
- Deployment on structure – mounting clamp
- Provide simple interface to retrieve data
Multipath is an effect caused by reflections, signals taking ‘multiple paths’

- Solid structures, seabed and sea surface
- Multiple signals at the receiver
  - Bad for traditional acoustics
  - Reflections interfere with the signal
  - Change length of burst
Digital acoustics can cope:

- Excellent time of arrival detection through digitally coded matched filter correlation
- Most direct signal received and decoded - the rest appears as background noise

The most direct route may not be ‘line of sight’

- 491 days deployment logged
- 1432 requests for data
- 89.5% communication success
Challenges: Battery Life

Scheduled Sensor Readings
- Subsea equipment in low power state between scheduled readings
- Long life Lithium Thionyl Chloride batteries

Battery life readings
- Data collected to date records < 10% battery life used in approx. 500 days of activity
- Projection indicates deployment possible beyond the original five year target
Suitable for > five years deployment
- Recreate existing design in PVC
- PEEK connectors
- Stainless Steel protection cages with zinc anodes

Mounting to platform
- Deepwater RetroClamp, mount electronics, battery and reference electrode
- Separate electronics and battery housing to balance RetroClamp for ROV deployment
- Installation in approx. one hour
Reference cell readings
• Polarisation of platform structure ‘stable’
• Identified periods where ICCP system has been turned off
• Verified distribution of CP across structure
• Overlay ICCP input readings with CP readings from the structure
Success: Ongoing Advantages

- Accurate and repeatable CP data available on a regular basis from each monitoring point
- Verify and monitor the level of performance from the ICCP system
- Optimise protection to maximise life of asset
- No ROV needed to recover sensor data, or drop cell surveys to measure CP potential
- No relay stations for outlying monitoring points
  - Longer range than through water RF or optical
- Avoid multiple cables through splash zone
- Speed of deployment
- Deployment beyond five year target
Further Questions

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