Stork Innovation Stork创新

Seatooth® Cathodic Protection

世界第一套：海底阴极保护 无线实时监测系统

World's first subsea wireless Cathodic Protection (CP) monitoring system.

Client challenge

Cathodic protection (CP) is essential to subsea asset integrity. But getting accurate and reliable CP condition data can be a challenge, especially when critical locations are not accessible due to geometry, location (e.g. splash zone) and/or burial.

Solution

Instead of having to physically touch CP anodes, a Seatooth® CP enabled anode can wirelessly transmit over 100 monthly collected data points to an ROV that periodically comes by. This takes care of hard to reach anodes and provides vastly more data points than the traditional method (1 reading per ROV visit).

Client benefit

- Reduced risk of asset failure (unsafe situations, release of hazardous materials and/or loss of production)
- Greatly reduced cost related to collecting data, pre-mature replacement and/or retrofit of sacrificial CP systems
- Increased confidence in the (extended) life span of subsea systems

Proof

Seatooth® CP is part of the WFS Technologies family of wireless instrumentation systems already deployed by North Sea operators and subsea construction contractors.

客户的挑战:

阴极保护（CP）对于海底设备完整性是必须的。但是，获取准确和可靠的CP状况参数是一个挑战，特别是，由于几何，位置（比如喷溅区域）和/或填埋区域，关键位置到达困难。

方 案:

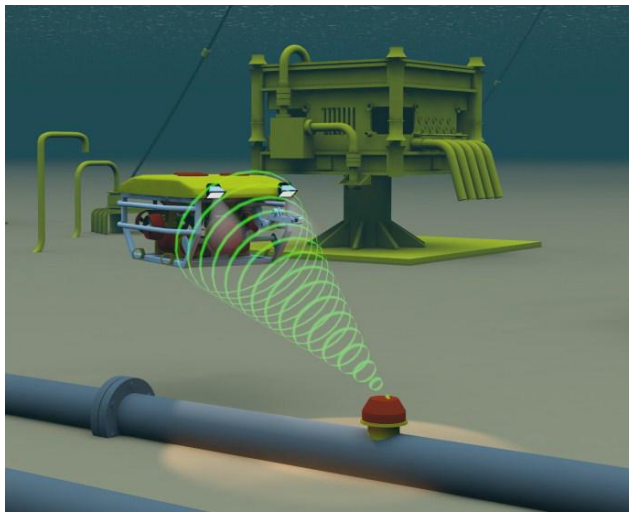
不同于与CP阳极物理直接接触，一个海牙CP能够让阳极无线传输超过100个月收集的数据点到定期路过的的ROV上。相对于传统的方法，这样照顾到接近阳极的困难和提供海量的数据点。（每次ROV访问读取一次）。

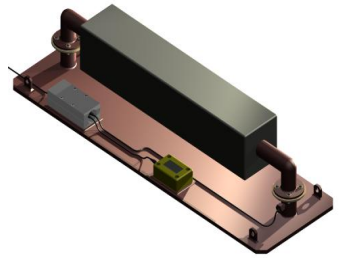
客户受益:

- 减小设备故障的风险(不安全的情况，危险物质的释放和/或生产损耗）.
- 极大降低收集数据的成本，提前更换和/或对CP牺牲阳极进行改造。
- 对海底系统寿命的延长更有信心。

业 绩:

海牙CP系统是WFS技术无线仪表系统家族的一员，该仪表系统已经由北海操作人员和海底承建商布置完成。





Illustrative platform retrofit monitored anode

Industry First Innovation 海底阴保 无线实时监测系统详细介绍 *Seatooth®*

Seatooth CP

Seatooth CP takes a step away from the traditional method of data collection for passive Cathodic Protection (CP) by measuring anode current output wirelessly using an ROV.
The main difference between Seatooth CP and a conventional system is that each monitoring point (node) converts the local potential to a digital stream. The digital stream is transmitted wirelessly through a networked monitoring system, minimising any cabling. This means that the total wiring burden for the system is a single cable from the anode or reference electrode. Data is collected wirelessly from the anodes by ROV without requiring wet-mate connectors or wires for data transfer and the ROV will not need to"dock" in order for transmission to take place.

The system captures potential and current density measurements at numerous points around the structure and retains the data ready for upload. The values can be recorded at regular intervals, to provide accurate performance trending information, including strategic information on anode consumption; moving
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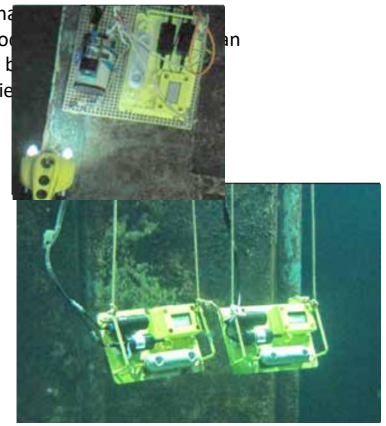


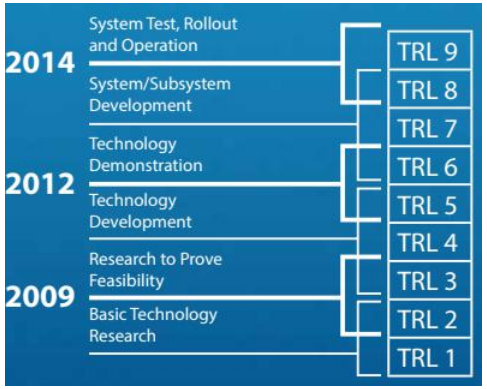
Seatooth CP

World's first subsea wireless Cathodic Protection (CP) monitoring system.

In May 2013, Stork launched an international industry first innovation named Seatooth CP in conjunction with WFS Technologies, a global organisation which delivers underwater wireless instrumentation and control solutions to the Offshore Oil & Gas and Renewables industries.

Seatooth CP underwent rigorous research and development by combining Stork's current CP capabilities and engineering teams with wireless technology from WFS. The newly established innovation monitors the effects of corrosion by measuring anode current wirelessly in "real-time" using a Seatooth S100 device and a wireless enabled ROV.

Although Seatooth CP is in the early stages of market penetration, the technological development has generated a large amount of interest with a number of major Oil and Gas Operators. The below diagram illustrates each Technology Readiness Level (TRL), a NASA approved staging process, that Seatooth CP has underwent. Now at the 'technical demonstration stage', Stork and WFS will be working closely together in 2014 to progress through to the final TRL, "System Test, Roll and Operation".



By partnering with another pioneering organisation, Stork has again produced an industry first system. No other technology currently offers this capability or the potential to gather data wirelessly in real time and therefore Seatooth CP signals a significant advance in Subsea Asset Integrity Management.

System Components:

The monitoring assemblies can be located on various parts of the structure to provide a complete picture of the condition of the cathodic protection system. Every assembly in place on the structure gathers a different set of data. All of the assemblies are connected to a master module which then transfers the data to the preferred location of the operator. The transfer process is completed digitally to ensure the integrity of the data is maintained throughout the system.

Master Module:

The master module collects the data from each of the monitoring assemblies and transmits it to an onshore location. As the hub of the system, Stork designed the module with built-in redundancy to ensure it is durable and efficient. As a result the master module contains a number of innovative features.

Master Module features include:

- A source of rechargeable power for the module and each of its assemblies
- A long term and permanent data storage device
- Inductive coupling for recharging the power source
- The ability to record the time with every reading

Benefits:

- Accurate cathodic protection performance data
- Extensive monitoring system life using rechargeable power source technology
- ROV friendly equipment for both fitting and data recovery
- A variety of sensors including, coupons, temperature, conductivity, oxygen, and monitoring
- Permanently deployed sensors with no wet mate connectors
- Retrofit capability makes the system suitable for brownfield or greenfield
- Wireless data management with ROVs
- Pre-configure sample rate to match condition of anode
- Battery life up to 15 years
- Wireless recharge (optional)
- Data through splash zone
- Open architecture allows for additional senor inputs

The combination of anode current and continuous data collection allows an accurate calculation of the end of life of a sacrificial anode. Stork's CP Engineer can extrapolate what weight of anode material is required to provide optimum levels of CP based on actual conditions of the structure. This data is collected by mini-ROV whilst on routine maintenance flights and indicates to the Engineer when to apply the retrofit or plan the maintenance, rather than waiting for assets to corrode. The "real time" gathering of this data signals a significant advance in asset management.

When both active and passive forms of CP are employed (for example on a floating platform) a potential system imbalance may reveal a "corrosion hot spot", causing assets to corrode more quickly. Seatooth® CP assists with "balancing" and optimising the system by pinpointing the cause of the imbalance with regular and relevant data and indicating where early action is required to avoid asset deterioration.

By distributing a number of Seatooth CP units throughout a subsea field it will also be able to determine the locations of current sinks or drains. A wireless CP system has a number of advantages over a wired system. The wireless nodes can be placed in locations not accessible to ROV, giving a full view of the system being monitored and avoiding the need to hardwire these into place. Each node's field life can be extended with wireless power transfer technology and is flexible enough to be retrofit on brownfield as well as designed into greenfield sites.

All of the nodes can be read by single command making acquisition quick and efficient, and because the nodes are fixed the owner is guaranteed consistency and accuracy of each reading. Also by converting analogue values to digital values, measurement errors caused by electrical interference or water leaking into the cables are eliminated.