Offshore cathodic protection anode retrofitting

SVT Engineering Consultants (SVT), working in a challenging marine environment, designed a cathodic protection solution to a potentially expensive problem.

PTTEP Australasia (formerly Coogee Resources) until the end of 2010 operated two Floating Production, Storage and Offload Facilities (FPSOs) located in the Timor Sea. The Challis Venture and the Jabiru Venture were located approximately 650 km off-shore west of Darwin. Onshore logistical support was based in Darwin and supplemented with a Perth-based engineering support and administration team.

FPSO’s
These facilities are usually ex-tankers converted for the processing of hydrocarbons through a process unit on deck. Product is stored in tanks below deck and offloaded to shuttle tankers at regular intervals. FPSOs are cheaper and easier to install than fixed platforms and do not require local pipeline infrastructure to export oil back to shore.

The operation and function of an FPSO is different from a normal tanker in the following ways:
- it is moored in one offshore location for long periods of time;
- regular dry-docking may not always be possible; and
- unlike other shipping, the external corrosion protection systems can be interfered with by offload piping, risers, mooring lines and turret structures being in close proximity to the hull.

Cathodic Protection Systems
The National Offshore Petroleum Safety Authority (the governing body for offshore Oil and Gas production in Australia) and the Classification Societies (in the case of PTTEP - Lloyd’s Register) regulate the operation of these vessels. They both require that the facility operator have a robust and comprehensive corrosion management plan in place that ensures the integrity and protection of the hull against corrosion.

During construction, both FPSOs had cathodic protection systems installed. These were forward and aft transformer rectifier units:
- Challis Venture: 1 x 350 A (forward) and 1 x 350 A (aft)
- Jabiru Venture: 1 x 100 A (forward) and 1 x 450 A (aft)

SVT carried out a site review of the cathodic protection systems and the effectiveness of protection being provided. In both cases, these systems were found to be functioning, but were nearing the end of their service life as several of the hull mounted impressed current anodes had failed.

Anode Replacement
Both FPSO facilities were nearing decommissioning and a cost effective solution was essential given their limited life expectancy. SVT’s Corrosion & Materials group was asked to provide an innovative and economical method of anode replacement.

SVT first reviewed the various options and methods of installation in conjunction with the PTTEP engineering team.

The anode replacement review considered essential criteria:
- installation requirements (based on the isolation of the facilities);
- anode output capacity;
- cyclone resistance;
- the event of the FPSO being disconnected from the turret and moving (a possibility due to cyclonic activity); and
- ability to move with the FPSO as it swings with the prevailing winds around the riser/turret.

The review considered the following options for repair:

1. Replacement Hull Mounted Anodes
To replace the existing hull-mounted anodes (as originally installed) would require the mobilisation of a dive crew of four to five men, plus all equipment, to the facility. This would have resulted in a significant associated cost, significantly above that of the anode elements.

In addition to the anode replacement, for this option the dielectric shield previously applied would also have had to be reinstalled underwater. This shield consists of a thick epoxy material, up to 1 m in radius around the anodes. This would have added a significant increased cost due to the extended dive time. This option was therefore eliminated on cost grounds.

2. Remote Sled Anodes
To install remote sled anodes would have required the mobilisation of a vessel and the support of a ROV (Remotely Operated Vehicle). These anode sleds are placed on the sea floor and feeder cables deployed from the anode sleds to the transformer rectifier units within the FPSOs. There was concern that feed cables could potentially foul the transfer hose used to offload from the FPSO to oil tankers. An additional concern was that if the FPSO was disconnected from the turret and moved (due to bad weather) the anode sleds would have had to be abandoned. This option was also rejected.

3. Suspended Anodes
SVT’s solution was to design and install innovative suspended anodes as the most cost effective option. The added benefit of this arrangement was that site personnel could carry out a large portion of the installation work fitted in around existing maintenance tasks.

The cantilevered suspended anode system design also eliminated the need to mobilise either a diving crew or ROV to site. The anodes were also designed to be retrievable and installed so that the normal maximum roll of the FPSO would not cause contact of the anode/cable with the hull.

Two anodes were installed at the stern of the Challis Venture and two anodes were installed at the forward of the Jabiru Venture, the locations being chosen to be similar to that of the failed anodes. The anodes were connected to the existing transformer rectifiers (TR) and all the original anodes disconnected from that TR.

All anodes were lead-silver alloy and the location were selected to replace the depleted anodes.

Results
Potential measurements during the commissioning of the retrofitted anodes indicated that both FPSO hulls achieved adequate protection levels. Further reports from the FPSOs indicated that the anodes continued operating at the pre-set output current, and adequate protection levels were maintained until the Jabiru Venture and Challis Venture were decommissioned at the end of 2010.

This cantilevered suspended anode system proved to be an inventive and cost effective measure to extend the life of an FPSO cathodic protection system. Where vessels are not able to be dry docked for extended periods, this could provide a temporary solution that is both flexible and cost-effective.