

# Fremantle Ports – Protecting the Unseen

## Introduction

In May 1897 Fremantle Ports' Inner Harbour was officially opened bringing increased trade into Western Australia. One hundred and fourteen years later in 2011, the Port saw 26 million mass tonnes of trade pass through its facilities at a value greater than \$25 billion.



Busy times at Fremantle Ports

Fremantle Ports is a harbour seemingly forever in expansion. With imports and exports increasing, 2011 alone saw Fremantle receive 1952 shipping visits. Vessel capability and size is increasing and capacity for container storage is at a premium. To ensure the Ports can meet the requirement to handle larger vessels, receive the increased container throughput and store the additional containers, means a continual improvement to Port facilities.



Lining them up – Berthing at Fremantle

In 2009/10, Fremantle deepened the Inner Harbour and Entrance Channel to 14.7 metres and the Deepwater Channel to 16.5 metres, allowing larger vessels to enter the port fully loaded. The project also involved strengthening of the North Quay container berths to cater for the heavier loads the bigger ships impose on wharf infrastructure.



Queen Mary 2012

## Corrosion concerns

Further to addressing improvements in Port throughput, Fremantle has been attacking (over many years) other less seen, and critical, issues occurring below deck level. Accelerated Low Water Corrosion (ALWC) and Microbially Influenced Corrosion (MIC) are the main corrosion morphologies identified at Fremantle Ports resulting in significant degradation to steel support piles.

Substrate loss through ALWC was the first concern identified at the Port (both Inner and Outer Harbours) more than ten years ago and a dedicated petrolatum tape wrap system with HDPE overlay was implemented to assist with corrosion management. Pile wrap removals and inspections have identified great success in this system at the attack zone, predominantly at the splash zone and approximately 500mm below low water level.

In 2004, the first reported MIC was observed on the submerged portion of the steel support piles and sheet-piling within the Fremantle Inner and Outer Harbours, identified by the presence of what has been described as the "Orange Bloom". The presence

of this "Orange Bloom" has been directly linked to increases in corrosion rates of the underlying substrate. Further inspections and testing located substrate loss and pile perforations (in certain areas) below the level of the wrapping project and within the locations of identified "Orange Bloom".

As a result of an increase in identified corrosion to steel support piles outside the protected wrap zones, Fremantle Ports have undertaken a comprehensive Inner and Outer Harbours Cathodic Protection Management Plan incorporating Impressed Current Cathodic Protection (ICCP) Systems (Sacrificial Anode and Impressed Current).

## Project Scope of Works

Innovative Corrosion Management (ICM) commenced the design, supply and installation of the ICCP systems for the Inner Harbour in 2007. Fremantle Ports requested an ICCP system with a projected 30 year service life, with a specified protection potential of -900mV vs. Ag/AgCl reference cell, to allow for protection against MIC. Design works were first completed taking into consideration both immersed and embedded zones of

steel support piles and with particular consideration to the difficulty of access, cable runs and anode and TR Unit placement. Design check and verification was provided by Mr John Grapiglia to ensure all aspects of the CP design were adequate to provide the final design requirements.

Over a five year period working in with shipping schedules and project budget allocations, ICCP systems have been installed to Berths, 4, 5, 6, 7, 8, 9, 11 and 12 at Fremantle Ports.

In total ICM have installed the following as part of system installation:

- 27 off 200 amp Transformer Rectifier Units supplied by M Brodribb. All TR Units had to be installed below berth deck.
- Eighty four (84) off Mixed Metal Oxide anodes supplied by NMT electrodes.
- In excess of 3.5km of cabling.
- ICCP Remote monitoring units operating to provide system emails for real time notification of unit status (on/off).

## Project Considerations

With a port facility operating on a 24hr 7 day basis, access to the steel support piles and berths was a major challenge to maximise man hours on site and reduce downtime due to shipping. With shipping taking precedence over installation works, constant contact with Fremantle Ports Operations to determine berthing status dictated which berths ICM could work on. Having several

berths available under each contract enabled movement around the berths depending on shipping, reducing project stand down time.

The most difficult aspect of CP installation on this project was the access restrictions due to limited walkways below the berths and congestion with new and old steel support piles taking up considerable room below decks making manoeuvring and accessing locations at times of high tides almost impossible. In the end, rigging experience and expertise became one of the most valuable asset to CP installation in particular at stages of manoeuvring and installing the TR Units below deck level, supported from the deck soffit.

## System Operations

Prior to commissioning of the CP units throughout the berths it was apparent that, ensuring continuity of the system and piles was going to be a significant consideration with the berths being all of varying ages and construction methodologies. CP was not a consideration for bonding and continuity at the time of original berth construction, a practice that has changed with all new berth works at the ports implementing good bonding and continuity practices and provision for CP installation. On commissioning, piles that did not meet specified protection criteria were mechanically bonded and all piles are now achieving specification requirements.

Fremantle Ports have also undertaken a dedicated monitoring and maintenance regime for the systems with ICM providing this service in accordance with the guidelines of AS 2832.3

In 2011, ICM worked with Fremantle Ports to increase awareness of the CP systems at the Port, with the biggest concern being CP Units being turned off for project works, and not being re-energised for extended periods. To this end, dedicated remote monitoring capabilities with real time email notification of TR Unit status (on/off) have been installed which has eliminated unnecessary CP downtime.

## Fremantle Ports' Viewpoint

The installation of the various Cathodic Protection Systems within the Inner Harbour over the past few years, has been a total success and has totally met Fremantle Ports expectations. The 2000 or so tubular steel piles supporting the various wharfs are of vital importance to the Port to ensure that the berths continue to operate well into the future.

All works were undertaken within project specifications, timeframe, budget and with no safety concerns or lost time injuries.

In addition, and of particular note, is the amount of time and effort given by the contractor to details and of the technical support, expertise and advice provided over the years.

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Typical steel pile layout under wharf structure



Typical CP Transformer Rectifier Unit



Typical Remote Monitoring Unit