



# Corrosion Technology Services

Case Study - E2584/08

## CP of Concrete Caissons, Piers and Quays at NSRY, Qatar

<b>Start:</b>	January 2009
<b>Completion:</b>	November 2010
<b>CP Project Cost:</b>	US\$ 7 million
<b>Scope of Project:</b>	Cathodic Protection of 53 Reinforced Concrete Caissons and 2km of Reinforced Concrete Piers and Quays

### Introduction

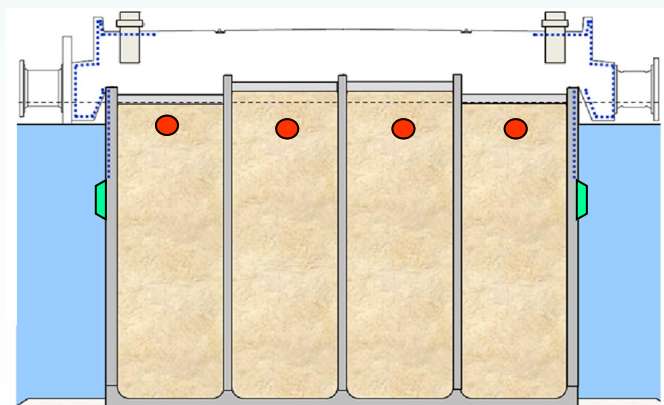
The Nakilat Ship Repair Yard is located in Ras Laffan Industrial Complex, Qatar. Spread over 43 hectares, it contains an assortment of workshops, buildings and over 2km of quays and piers. The quays and piers are constructed from 53 pre-fabricated caissons. The caissons are cellular in design with dimensions of 36m x 16m x 11m and weigh around 4,000 tones each. Due to severe environmental conditions and the owners experience of corrosion on similar structures Cathodic Protection (CP) was specified to protect the rebar.



Nakilat Ship Repair Yard (July 2009)

### Description of the CP System

Impressed current systems using ribbon mesh and canistered anodes were installed to protect the caisson and deck-slab reinforcement with a design life of 50 years. Sacrificial anodes provide temporary protection to the submerged steel during construction and will provide CP to the external reinforcement once the system is fully operational. The CP system is monitored using CTS monitoring clusters. A monitoring cluster consists of an Ag/AgCl reference electrode to measure the potential of the steel and a monitoring coupon to measure current pickup and IR free potentials. Each caisson section has 24 monitoring clusters embedded in the concrete.



- MMO Canister Anode
- ▲ Sacrificial Anode
- Ribbon Mesh Anode

Cathodic Protection System Overview



# Corrosion Technology Services

Case Study - E2584/08

## CP of Concrete Caissons, Piers and Quays at NSRY, Qatar

### Impressed Current CP Systems

#### **Canistered Anodes**

With exception to external seaward facing walls all reinforcing steel is protected by MMO coated Titanium tubular anodes. Two anodes pre-canistered in coke backfill were installed horizontally in each of the 28 caisson cells.



Placement of canistered anodes into a caisson cell

#### **Ribbon Mesh Anodes**

MMO coated Titanium ribbon mesh anodes protect external reinforcement of atmospherically exposed concrete surfaces, as follows:

- Top 3.5m of caisson walls
- Sides of the deck-slab and 2m into the horizontal surface
- Pre-cast fender panels and service pits

### Sacrificial CP System

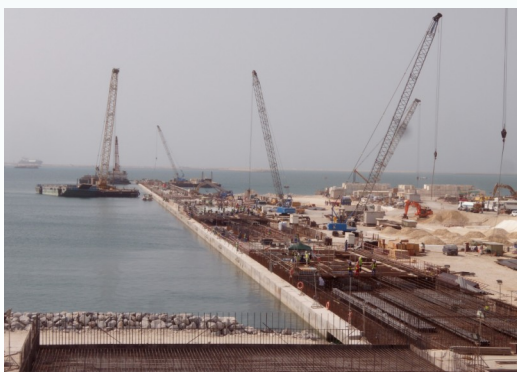
Vertically mounted 155kg Aluminum (Al,Zn,In) sacrificial anodes protect the external reinforcement below the waterline. The anode mounting brackets are embedded in the concrete and electrically isolated from the reinforcement. Each group of anodes along a single wall are connected in series by cable. Connection to the reinforcement is through an electronic current limiting device.

### Power and Monitoring

The ICCP systems are powered by 53 multi-channel air-cooled transformer rectifiers (TR's). The TR's are located in substations within the piers and quays.

An Aegis Remote Monitoring and Control System has been utilized. The system can be accessed from any location via the internet. Some features of the system are summarized below:

- Control all TR functionality
- Continuously monitor and automatically generate alarms/reports.
- Measure and storage of output voltage and current on demand or to a pre-selected schedule.
- Performance verification testing



One out of four piers

### Project Statistics

- >100,000 m<sup>2</sup> of concrete protected
- > 2,500 canistered anodes installed
- >135,000m of ribbon mesh anode installed
- > 96 tones of sacrificial anodes installed
- > 900 zones