



Corrosion Technology Services

Case Study - CC837

CP of Bridges at Durrat Al Bahrain

Start:	April 2003
Completion:	May 2005
CP Project Cost:	US\$ 2.5 million
Scope of Project:	Cathodic Protection of 13 Bridge Soffits, Abutments and Pile Heads

Introduction

Durrat Al Bahrain is a luxury resort, located on the south coast of Bahrain. It includes 13 islands with over 5,000 villas and apartments. The islands are joined together by 13 architectural bridges with a total length of over 3.5km. The total project value is in excess of US\$ 3 Billion.



Durrat Al-Bahrain

The bridges were designed with aesthetics in mind, and the bridge decks sit only 2m above the warm and saline Arabian Gulf, which presents a large durability risk. To overcome this problem it was decided that either Stainless Steel reinforcement or Black Steel Reinforcement with Cathodic Protection (CP) would be used.

Stainless Steel vs. Black Steel with Cathodic Protection

A feasibility study was carried out between Stainless Steel and Black Steel with CP which focused on maintenance, aesthetics and cost. Due to the high perceived maintenance activities and the potential impact on the bridge aesthetics, the owner was reluctant to use CP.

However maintenance activities associated with CP systems were minimized to acceptable levels by using a remote monitoring and control system.

To reduce the impact of CP on the aesthetics of the bridges, cables were routed through pre-installed conduits and service ducts and the Transformer Rectifiers (TR's) were installed inside the service pits within each bridge deck.



The Elegant Aesthetics of the Bridge

A cost comparison between the two options clearly highlighted that Black Steel with CP was significantly cheaper than Stainless Steel.

- Stainless Steel US\$ 27 million
- Black Steel with CP US\$ 7 million
- **Cost Saving US\$ 20 million**



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Cathodic Protection: Scope of Protection

The following surfaces of each bridge are Cathodically Protected:

- Underside of the bridge deck (soffit)
- Atmospherically exposed reinforcement of the abutments
- Atmospherically exposed reinforcement of the pile heads



Anode Installation on Bridge Soffit

Description of the CP System

An impressed current system consisting of MMO coated Titanium anode ribbon mesh was installed. Two reference electrode types were used to combine accuracy (Ag/AgCl) with longevity (MMO electrode).

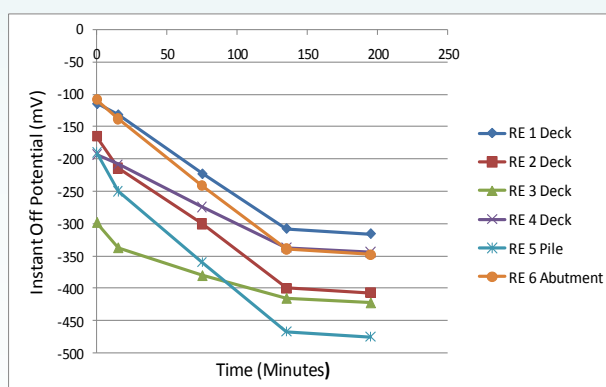
The embedded components and cable were installed during the pre-cast construction of each bridge section. The CP system is powered by a network of 102 TR's.

The TR's within any given bridge are networked using RS485 communication. Each bridge has a control unit that can operate the TR's of that bridge. Each bridge is in turn networked back to the master control unit using an optical fiber network.

Commissioning and Performance

To confirm the performance of the CP system the following commissioning procedure was followed using a temporary power supply due to a lack of AC power:

- The reference electrode potentials were recorded over a 4 hour period
- The polarization of the steel was calculated by measuring native and instant off potentials



The graph above shows the results from bridge 1. After 4 hours the steel had polarized by over 100mV at all RE locations, indicating sufficient protection had been achieved.