Corrosion Technology Services

Case Study - C939

Rehabilitation of Concrete Seawater Intake Structure

Start:	2003
Completion:	2004
CP Project Cost:	US$ 2 million
Scope of Project:	Rehabilitation of a Reinforced Concrete Sea Water Intake Structure

Introduction

CTS were commissioned to undertake the rehabilitation of a Sea Water Intake structure in Bahrain. The structure was built in 1985 and was showing signs of corrosion damage for several years. A more permanent solution to corrosion problems was required so Cathodic Protection (CP) was specified by the owner.

Description of the CP System

Due to the complexity of the structure different types of CP systems were used. The CP was required to extend the life of the structure for at least 25 years.

The existing below waterline CP for the screens and pumps was upgraded to include protection for the submerged part of the concrete reinforcement.

Above water level the structure was divided into tidal and atmospheric zones. MMO coated Titanium ribbon mesh, expanded mesh and discrete anodes system were installed.

Shotcrete Guniting Over Expanded Mesh

Reference Electrode Installation in Expanded Mesh Wall

Zoning and Monitoring

The system was divided into zones and sub zones to suit construction and to allow for good current distribution and control.

The system is monitored using Ag/AgCl reference electrodes (RE's) which are embedded in the concrete. RE's were distributed in order to give a comprehensive analysis of the CP system. There is a minimum of 4 RE's installed per zone and 1 installed per sub zone .

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Ribbon Mesh Anodes

Ribbon mesh anodes were installed in slots or chases depending on the depth of the concrete cover and filled with proprietary grout. In some cases the anodes were installed directly onto the scabbled concrete surface and overlaid with shotcrete.

In areas of severe corrosion entire concrete sections were replaced. In these areas the anode was installed directly onto the rebar before the concrete was poured.

Slotted Anode Installation in Slab

Holes Being Cored in Sea Wall

Discrete Anodes

The sea wall area of the structure was inaccessible to slotted or mesh anode systems. In these locations discrete anodes were installed vertically between the reinforcing steel. Holes were drilled up to a depth of 2m and connected using Titanium conductor bar. Free flow grout was used to encapsulate the anodes. Before installation, testing was carried out to ensure that effective encapsulation was possible.

Below Water CP

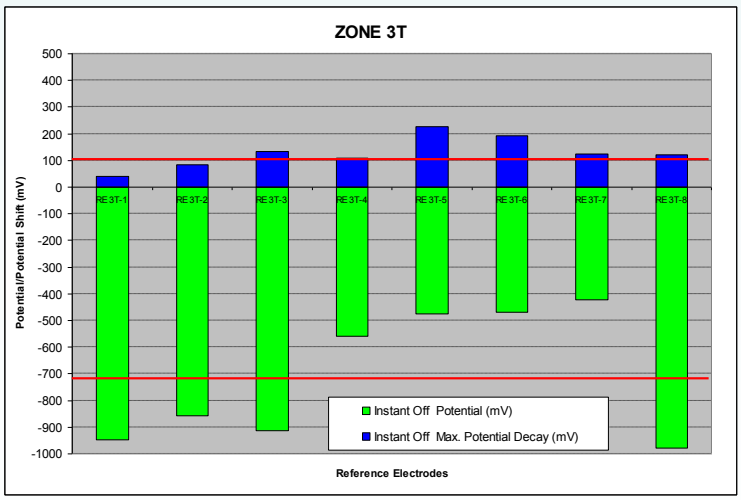
For the below waterline reinforcement the existing CP system was utilized. Calculations proved that the existing Transformer Rectifiers (TR's) had sufficient capacity to include the increased demand of the submerged reinforcement.

Commissioning

To allow for an effective design the following two criteria were used to assess the CP system:

- Minimum decay of 100mV from instant off
- Instant off potential more negative than –720mV with respect to Ag/AgCl.

Typical results are displayed in the graph opposite. The graph shows that all locations pass at least one of the criteria and two locations pass both.



Typical Commissioning Graph (Tidal Zone)