PART 5
SACRIFICIAL CATHODIC PROTECTION

GRANVILLE ISLAND MARKET
PEDESTRIAN WALKWAYS
STRUCTURAL MARINE PILES

Materials, Construction & Inspection

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Project Drawing: CSCL Dwg. Set #0494, Sheet 01

1.0 GENERAL

Provision of materials and services covering the installation of sacrificial cathodic protection for select existing steel marine structures at Granville Island Market, Vancouver B.C. In summary the project includes supply and installation of aluminum anode assemblies. The anodes, mounting hardware and miscellaneous other materials including delivery to the site will be the responsibility of the Contractor. For further details reference project drawing 0494, Sheet 01.

2.0 MATERIALS SPECIFICATION

2.1 SACRIFICIAL ANODES

2.1.1 Anode Suppliers

2.1.1.1 Purity Metals, Langley, B.C.

2.1.1.2 Canada Metal, Delta, B.C

2.1.2 Sacrificial Anodes Type

- Type 1 Aluminum Anode (96 Kg)
- Quantity – As shown in the schedule of quantities

2.1.3 Anode Dimensions

2.1.3.1 The dimensions and other details for the Type 1 anodes are noted on Drawing 0494-01, “Sacrificial Anode Details”.

2.1.4 Anode Pipe Core

2.1.4.1 The Type 1 anode core is fabricated from continuous steel pipe having a 60-mm outside diameter and a 5.5 mm wall thickness (2 inch inside diameter, Sch.80). Refer to contract drawings.

2.1.4.2 The Type 1 pipe cores are weldable steel pipe conforming to one of the following steel types:

API 5L Grade B

ASTM A – 106 Grade A or B

BS 3602 HF5 27

2.1.4.3 The Type 2 anode is cast onto a 25mm galvanized wire rope (6 strand x 19 wire).

2.1.5 Aluminum Anode Alloy Material Composition

The aluminum alloy composition shall be to US Military Specification MIL-A-24779 (SH) – latest edition as follows:

Aluminum Alloy Chemical Composition	
Element	**Weight (percent)**
Indium	0.014 - 0.020
Zinc1	4.0 - 6.5
Silicon	0.08 - 0.20
Copper	0.004 maximum
Iron	0.090 maximum
Mercury	0.001 maximum
Tin	0.001 maximum
Others (each)	0.020 maximum (total not to exceed 0.10 percent)
Aluminum1	Remainder

1 - Aluminum raw material purity shall be 99.8 percent by weight (minimum).

Test efficiency of the aluminum alloy in open sea water shall not be less than 85 % based on 100 % efficiency of 2500 ampere – hour per Kg. The aluminum alloy shall have a close circuit potential in seawater of not less than – 1.05 volts versus silver-silver chloride reference electrode.

2.1.6 Anode Surface Irregularities

2.1.6.1 Shrinkage depressions on the anode surface shall not exceed 10% of the normal height of the anode as measured from the uppermost corner of the bottom depression.

2.1.6.2 Not more than 1% of the total surface of the anode casting shall be contaminated with non-metallic inclusions visible to the naked eye.

2.1.6.3 The straightness of the anode shall not deviate more than 2% of the anode nominal length from the longitudinal axis of the anode.

2.1.6.4 Within the anode section transverse cracks of the unlimited length and depth are permitted if width does not exceed 5 mm and there are no more than 10 cracks per anode. Small dense cracks shall be considered one crack and cracks of 0.5 mm width shall be ignored. Longitudinal cracks are not permitted in any length except in the final “topping – up“ metal at shrinkage depressions.

2.1.7 Certificate of Conformity and Identification

2.1.7.1 The anode manufacturer shall obtain representative metal samples from each alloy heat and analyze the same to prove compliance with the specified metallurgical composition. Test results are to be documented with reference to the batch numbers and supplied by the vendor complete with a certificate of

conformity certifying that the anodes comply in all respects to the specification.

2.1.7.2 Each anode shall be marked with its unique heat number and manufacturer's name. For heat-treated anodes, a heat treatment batch number shall be provided on each anode

2.2 ALUMINUM ANODE MOUNTING FITTINGS

2.2.1 All components are of weldable low carbon steel conforming to one of the following types: CSA G40.20, CSA G40.21, GRADE 300 W.

2.2.2 The Type 1 anode " mounting bracket" will consist of two parts:

1. Anode Attachment Plate: Fabricated from steel plate 100mm x 200 mm x 10mm flat bar. A vertical elongated hole 30mm long x 22mm is included to accommodate the installation of the anode.

2. Structural Channel: Fabricated from steel channel 127mm x 47mm x 150mm long (CS X 9). It will consist of a bolt (carbon steel or stainless steel) through the channel with the head welded to the inside of the channel as per drawing. Each bolt will be of 20mm diameter x 64mm Hex Head Screw Bolts having National course thread – 4 threads per cm (NC-10 threads per inch) – complete with one 20mm lock washer and full regular hex nut per bolt. Material of construction shall be ASTM A 307 carbon steel standard fasteners or equal.

2.2.3 Two structural channels are required for each Type 1 anode.

3.0 EXECUTION & INSTALLATION

3.1 QUALIFIED INSTALLERS

3.1.1 Only qualified dive service companies should be engaged to complete the following work scope. B.C. area companies include:

- Canpac Divers, Vancouver, B.C.
- Hydra Marine, Vancouver, B.C.
- West Coast Diving, Nanoose Bay, B.C.

3.2 WELDING

3.2.1 Dry Welding Procedure

3.2.1.1 Welding shall be in accordance with CSA W59-M1989, Welded Steel Construction, except where specified otherwise.

3.2.1.2 All permanent welds shall be visually inspected by the Consultant and subject to non-destructive testing by MPI (Magnetic Particle Inspection) where deemed necessary.

3.2.2 Wet Welding Procedure

3.2.2.1 All underwater welding of the anode brackets including tack welds for electrical continuity shall conform to "ANSI//AWS D3.6-89 or latest revision, for underwater welding, "Type C Weld" or a welding procedure proposed by the contractor which provides a crack free weld equal to AWS D3.6M-1999, Class C weld and is acceptable by the Engineer.

3.2.2.2 Welding procedures, welding materials and welders shall be qualified by testing weldments under actual site conditions and conducted at least one week prior to the intended project start date. No project welding shall be undertaken until the welder, procedures and materials conform to the standards noted in section 6.2.1.

3.2.2.3 The Contractor shall supply the necessary equipment and materials for these tests, which shall include plate fillet welds made in the vertical and horizontal positions by each diver welder. The weld procedure, materials and welder qualifications shall be submitted, along with test results, to the Consultant for review before any production welding begins. The Consultant shall be advised when test welding is to take place as he wishes the option of witnessing these welds and their testing. Test specimens may, at the discretion of the Consultant be subjected to destructive or non–destructive tests.

3.2.2.4 Each diver-welder shall provide two samples of each of the following welds for qualification purposes:

- Plate fillet weld – vertical position
- Plate fillet weld – horizontal position

These welds shall be completed under site conditions while the Consultant is present.

3.2.2.5 The qualification of the diver-welders shall occur at the start of the project prior to any underwater welding. Diver-welders certified to standards described in section 5.2.1 within the past year may submit documents to the project Consultant for approval.

3.2.2.6 Welding electrodes shall be metallurgically suited to the service involved and shall be specified in the welding procedure proposed by the contractor. Weld electrodes, type Broco "easy touch" or approved alternate, are recommended for underwater use.

3.2.2.7 Welding electrodes used for the weld qualification tests shall be used for the duration of the project.

3.2.2.8 Alternate welding electrodes may be use, however prior to using the substituted electrode, qualification testing must be conducted in accordance to section 3.1.2.3.

3.2.2.9 Permanent welds shall be visually inspected by the Consultant. Defects shall be corrected by the contractor prior to acceptance of the work.

3.2.3 Surface Preparation for Welds

3.2.3.1 The pipe surface in the vicinity of each weld location shall be cleaned of all marine growth, scale, oxide, paint, or other contaminants. The surface area cleaned shall extend beyond the weld limits at each location. Surface cleaning shall be to a bright metal finish.

3.2.3.2 Manual tool cleaning is not acceptable. Acceptable cleaning techniques shall include but not be limited to:

- high pressure water blasting
- mechanical power tool cleaning

3.2.3.3 Weld locations having general surface pitting in excess of 3 mm depth shall not be used. Instead, additional pile surface shall be cleaned until acceptable surface conditions are found. Pitted pile surfaces can be filled with weld metal and ground flat to provide a flush surface for welding.

3.2.3.4 Pre-cleaning of weld locations up to two days prior to welding is acceptable provided the cleaned areas are thoroughly recleaned using a wire brush immediately prior to welding.

3.3 ANODE INSTALLATION PROCEDURE

3.3.1 Pile Surface Preparation

3.3.1.1 Once the location of each anode assembly structural bracket or bond plate has been determined, the steel pile or bond plate surface in the vicinity of each weld location shall be cleaned of all marine growth, scale, oxide, paint, or other contaminants.

3.3.1.2 The surface area cleaned shall not be less than 200 mm square and shall extend at least 50 mm beyond the weld at each location. Surface cleaning shall be in accordance with the requirements of Section 5.3 “Surface Preparation for Welds”.

3.3.2 Anodes Positioning

3.3.2.1 The Aluminum Anode Assemblies are to be installed as noted on the referenced drawing with the attachment location not to exceed +/- 200 mm horizontally and +/-600mm vertically of the intended location.

3.3.2.2 Anode relocations beyond the above limits must be approved by the project engineer.

3.3.3 Aluminum Anode Structural Bracket (Channel & Plate)

3.3.3.1 The structural brackets shall be fitted into place using a mounting jig or other suitable means as provided by the Contractor and approved by the Consultant. The brackets must fit level, be equally spaced on both sides and be flush to the pile surfaces with no gaps between the brackets and the pile. The brackets are typical for all pile diameters.

3.3.3.2 Each weld must be inspected and any defects removed prior to the acceptance of the work.

3.3.3.3 The anodes shall be safely lowered and mounted onto the structural bracket making sure the anode plate fits securely onto the bolt. The anode will be tightly secured with lock washers and bolts in accordance with the drawing provided.

3.3.3.4 All extraneous equipment used to assist the installation of the anodes must be removed.

3.3.3.5 To ensure electrical continuity between anode and steel structure, one 25 mm, long tack weld shall be applied along the top of the anode bracket where it fits flush with the structural bracket. Wet Weld Procedure shall be used for the continuity weld.

3.3.3.6 A minimum 1000mm cable slack between the mounted bond plates shall be provided.

3.3.3.7 Final positioning shall be field determined and approved by the project engineer.

4.0 INSPECTION AND TESTING

4.1 Installation

The Consultant shall conduct inspection and testing of all works to ensure conformance with the project drawings and this specification including the following:

4.1.1 All underwater work including anode assembly placements and welding.

4.1.2 The dive Contractor shall facilitate inspection and testing of the installed works by the Consultant. For an underwater inspection of the anodes assemblies, welds, etc. the contractor shall provide a suitable video feed allowing for a complete visual inspection of the work.

4.1.3 The Contractor, at his cost, shall promptly repair any deficiencies identified by the owner's representative.

4.2 Commissioning Potential Survey

Potential Survey: The Consultant shall undertake a potential survey of the protected pile structures. Survey procedures shall be in accordance with National Association of Corrosion Engineers Standard SP0169-2013. All survey and testing work to be completed by a NACE certified technologist. Minimum testing requirements include:

4.2.1 Before installation of the anode assemblies measurement of static pipe pile potentials.

4.2.2 After installation of the anode assemblies measurement of protected pipe pile potentials.

4.3 As Constructed Drawings

The Contractor shall submit a set of white prints with marked changes in red and submit to the Engineer at the time of final inspection.