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September 19, 2013

Port of Olympia
Attn: Don Bache
915 Washington Street NE
Olympia, WA 98501

Subject: **2013 CATHODIC PROTECTION INSPECTION
SHORELINE CONTAINMENT WALL
CASCADE POLE SITE**

Mr. Bache:

On September 9, 2013, Norton Corrosion Limited (NCL) personnel completed an inspection of the impressed current cathodic protection (CP) system that protects the buried environmental containment wall at the Cascade Pole site from corrosion. Authorization to perform this work per Purchase Order No. 7839070 was issued July 26, 2013.

Work Performed

NCL thoroughly inspected all accessible components of the CP system to assure safe and reliable operation. The rectifier was thoroughly tested to assure proper operation of the unit and all of its components. Electrical components were cleaned to remove marine salt deposits. Current output measurements were recorded for individual anodes. Structure-to-soil potential measurements were recorded at representative test locations for the purpose of evaluating the level of CP being received. Both on and instant off potential measurements were recorded along the inboard and outboard sides of the wall while interrupting the output of the rectifier. Minor adjustments and maintenance were performed as necessary.

Criteria

NACE International has established criteria that indicate, when used separately or in combination, that adequate CP is being provided. NCL has evaluated your CP system based on the following criteria:

1. Adequate CP is indicated by a potential difference of -0.850 volts or more negative between a steel structure and a saturated copper/copper sulfate (CSE) half-cell. This criterion requires all voltage drops, other than those across the structure-to-electrolyte boundary, to be considered for a valid interpretation of the potential data. Instantaneous-off potential measurements recorded to account for the voltage drops (IR drop) have been used to evaluate the level of protection achieved. The equivalent

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criterion applicable to a saturated silver/silver chloride (sat. Ag/AgCl) half-cell is - 0.750 volts.

2. Adequate protection is also indicated by a cathodic polarization shift of not less than 100 millivolts. This is equivalent to the difference between the instant-off (polarized) and native (depolarized) potential measurements.

Results and Conclusions

The attached data sheets detail inspection results. Data obtained indicates the CP system was functioning properly. All equipment was in good and operable condition except two anodes and a half-cell that failed years ago as previously indicated. Structure-to-soil potential measurements indicated adequate protection was being received at all locations tested. No adjustment to the level of protection was necessary.

Recommendations

NCL recommends the rectifier voltage and current output is monitored and recorded at least once every 60 days. The system should operate near 5 volts and a minimum current output of 12 amps. The current may vary with the tide, increasing as water covers the anodes.

This system should be inspected on an annual basis, so your next inspection should be scheduled for summer, 2014.

NCL appreciates the opportunity to serve the Port of Olympia. If you have any questions or additional concerns, please contact our office.

Sincerely,

John F. Keppler, P.E.
Corrosion Engineer

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CP SYSTEM

DATA SHEET: 1 OF 3
NCL JOB: E-21107-M
DATE: SEPT. 9, 2013
BY: J. KEPPLER

SHORELINE CONTAINMENT WALL

Rectifier Information

Manufacturer:	Universal Rectifiers
Model No:	CSA-ASAI 20-40
Serial No:	011757
AC Input Rating	<u>115/230</u> volts, <u>9.9/4.9</u> amps, 1Ø, set to low primary
DC Output Rating:	20 volts, 40 amps
Anode Bed:	24 – 1 ½ "Ø x 60" cast iron canister anodes

Field Measurements

	<u>Reading</u>
Panel Meters:	4.7 volts 15.0 amps
Transformer (4/5 max.):	1/4
Portable Meter:	120.4 volts AC Input 6.193 volts AC on taps 4.462 volts 15.3 amps
Shunt (50A/50 mV)	15.3 mV

Weather: overcast, damp ground, mid to low tide, outgoing, 12:00 to 14:00 hrs.

Anode Output Measurements

<u>Anode Location</u>	<u>Shunt Reading</u>	<u>Current Output</u>
1 - West	4.9 mV	0.49 amps
2	0.0	0.00
3	3.1	0.31
4	3.7	0.37
5	7.7	0.77
6	9.1	0.91
7	7.7	0.77
8	8.1	0.81
9	7.7	0.77
10	7.2	0.72
11	7.7	0.77
12	7.9	0.79
13	8.3	0.83
14	8.0	0.80
15	8.0	0.80
16	7.6	0.76
17	7.7	0.77
18	8.1	0.81
19	7.7	0.77
20	8.0	0.80
21	0.0	0.00
22	3.1	0.31
23	6.1	0.61
24 - East	2.8	0.28

Shunts are 0.01 ohm.

Cathodic Protection Readings

Structure-to Soil Potential Measurements (volts DC ref. CSE)

<u>Location</u>	<u>Onshore of Wall</u>		<u>Instant Off</u>	<u>Offshore of Wall</u>		<u>Instant Off</u>
	<u>Native*</u>	<u>On</u>		<u>Native*</u>	<u>On</u>	
Portable Cell:						
Fence post 1		-1.120	-1.020	-0.750	-1.200	-1.082
Post 5, adj. E TS	-0.600	-0.842	-0.790	-0.696	-1.191	-1.077
Post 10	-0.665	-0.834	-0.821	-0.806	-1.299	-1.103
Post 15	-0.692	-0.847	-0.834	-0.814	-1.347	-1.022
Post 20	-0.692	-0.858	-0.843	-0.820	-1.374	-1.130
Post 25	-0.644	-1.318	-0.824	-0.833	-1.370	-1.132
Post 27, adj. rect	-0.630	-1.365	-0.872	-0.832	-1.389	-1.137
Post 30	-0.656	-1.394	-0.902	-0.840	-1.368	-1.142
Post 35	-0.699	-0.997	-0.889	-0.843	-1.382	-1.144
Post 40	-0.710	-0.911	-0.893	-0.844	-1.350	-1.146
Post 45	-0.691	-1.000	-0.912	-0.810	-1.272	-1.134
Post 50		-1.107	-1.052	-0.756	-1.218	-1.108
East T.S. (Post 5):						
Perm. Sat Ag/AgCl Cell	-0.596	-0.609	-0.585			
Port. Cell	-0.560	-0.774	-0.752			
Perm. Ag/Port. CSE			-0.129			
West T.S. (Post 48):						
Perm. Sat Ag/AgCl Cell		previously failed				
Port. Cell	-0.741	-1.005	-0.967			

Note: Native potentials were previously recorded in March 2012.

