



July 28, 2016

Port of Olympia
Attn: Don Bache
606 Columbia Street NW
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Olympia, WA 98501
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Subject: **2016 CATHODIC PROTECTION INSPECTION
SHORELINE CONTAINMENT WALL
CASCADE POLE SITE**

Mr. Bache:

On July 21, 2016, 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. Written authorization to perform this work was issued on June 2, 2016.

Work Performed

NCL thoroughly inspected all accessible components of the CP system to ensure safe and reliable operation. The rectifier was tested to ensure proper operation of all of its components. Current output measurements were recorded for individual anodes. Structure-to-soil potential measurements were recorded at representative test locations to evaluate the level of CP being received. Both on and instant-off potential measurements were obtained 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:

- 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. Instant-off potential measurements recorded to account for the voltage drops (IR drop) have been used to evaluate the level of protection achieved. The equivalent criterion applicable to a saturated silver/silver chloride (sat. Ag/AgCl) half-cell is -0.750 volts.

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- 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 for two anodes and a half-cell that failed years ago as previously indicated. The system had a total current output of 15.1 amps compared to 15.0 amps one year prior. NCL deemed no adjustment to the level of protection was required.

Structure-to-soil potential measurements indicated adequate protection was being received at all locations tested. Both permanent half-cells are out of acceptable limits and are no longer accurate enough for use. The level of protection along the shore side of the wall was substantially less than during the prior inspection. This was the result of dry soil conditions and low tide. Despite the reduced level of protection along the onshore side, the readings recorded along the offshore side indicate a similar level of CP to the prior year.

The system was installed in 2001 and should have a 30 year service life. Thus the anodes are approximately 50% consumed.

Recommendations

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

This system should be inspected on an annual basis; the next inspection should be scheduled for the summer of 2017.

NCL appreciates the opportunity to serve the Port of Olympia. If you have any questions or additional concerns, please contact our office. Should the Port have other corrosion concerns, we hope you will look to Norton Corrosion for support.

Sincerely,



John F. Keppler, P.E.
Principal Engineer

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CATHODIC PROTECTION SYSTEM

DATA SHEET: 1 OF 3
NCL JOB: O-22081-M
DATE: JULY 21, 2016
BY: J. KEPPLER

SHORELINE CONTAINMENT WALL

Rectifier Information

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

<u>Field Measurements</u>	<u>Reading</u>
Panel Meters:	4.8 V 14.0 A
Transformer (C4/F5 max.):	C1/F4
Portable Meter:	120.2 V ac Input 6.213 V ac secondary 4.494 V dc output 15.1 A dc
Shunt (50A/50 mV)	15.1 mV

Weather: 1100 hrs, 80°s F, dry ground, low outgoing tide.

Notes: Fluke 28. Interruption: 2 sec. off, 12 sec. cycle.

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DATA SHEET: 2 OF 3
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Anode Output Measurements

<u>Anode Location</u>	<u>Shunt Reading</u>	<u>Current Output</u>
1 - West	4.95 mV	0.495 amps
2	0.03	0.003
3	3.08	0.308
4	3.81	0.381
5	7.81	0.781
6	8.94	0.894
7	7.79	0.779
8	8.34	0.834
9	7.99	0.799
10	7.54	0.754
11	7.86	0.786
12	8.09	0.809
13	8.20	0.820
14	7.77	0.777
15	8.06	0.806
16	7.58	0.758
17	7.73	0.773
18	8.13	0.813
19	7.78	0.778
20	8.12	0.812
21	0.05	0.005
22	3.35	0.335
23	3.44	0.344
24 - East	2.57	0.257

Shunts are 0.01 ohm.

NORTON CORROSION LIMITED

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CATHODIC PROTECTION SYSTEM

DATA SHEET: 3 OF 3
NCL JOB: O-22081-M
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Cathodic Protection Readings

Structure-to Soil Potential Measurements (V dc)

<u>Location</u>	<u>Onshore of Wall (ref. CSE)</u>		<u>Offshore of Wall (ref Ag/AgCl[sat])</u>	
	<u>Native*</u>	<u>On</u>	<u>Native*</u>	<u>On</u>
<u>Portable Cell:</u>				
Fence post 1		-1.041	-0.750	-1.117
Post 5, adj. E TS	-0.600	-0.723	-0.696	-1.105
Post 10	-0.665	-0.827	-0.806	-1.236
Post 15	-0.692	-0.848	-0.814	-1.286
Post 20	-0.692	-0.842	-0.820	-1.314
Post 25	-0.644	-0.744	-0.833	-1.326
Post 27, adj. rect	-0.630	-0.742	-0.832	-1.319
Post 30	-0.656	-0.815	-0.840	-1.371
Post 35	-0.699	-0.874	-0.843	-1.326
Post 40	-0.710	-0.815	-0.844	-1.349
Post 45	-0.691	-0.902	-0.810	-1.166
Post 50	-1.088	-1.033	-0.756	-1.136
East T.S. (Post 5):				
Perm. Sat Ag/AgCl Cell	-0.596	-0.605		
Port. Cell	-0.560	-0.732		
Perm. Ag/Port. CSE		-0.470		- this cell is no longer functional.
West T.S. (Post 48):				
Perm. Sat Ag/AgCl Cell	previously failed	-0.773		
Port. Cell	-0.741	-0.796		

Note: Native potentials were previously recorded in March 2012.

RECTIFIER LOG

OWNER: PORT OF OLYMPIA – Cascade Pole Site

STRUCTURE: Shoreline Environmental Containment Wall

RECOMMENDED CURRENT OUTPUT: 12 to 16 amps (may vary with tide)

DATE	VOLTS	AMPS	TAPS	INITIAL	COMMENTS
7/21/2016	4.8	15.5	1/4	JFK	NCL annual inspection. Low tide.

For assistance, contact NCL at 425-483-1616.
John Keppler, mob. 425.501.3401