APPENDIX A

SAMPLE CORROSION MITIGATION PLAN

CESAM-EN-CE

TO: Chief, Engineering Division

SUBJECT: Corrosion Mitigation Plan for Lock B Miter Gates, Tenn-Tom Waterway

1. OBJECTIVE: The objective of the subject plan is to provide methods for corrosion mitigation of the submerged metallic structural components of the Lock B miter gates.

2. GENERAL: Lock B miter gates are located in a submerged corrosive environment in which the water resistivity varies, but generally ranges between 40,000-60,000 ohm-mm. Galvanic corrosion of the structural components of the lock miter gates can, and often does, result in deterioration of the structural integrity of the gates. This deterioration can affect the operation of the gates and often requires expensive repair and/or replacement of the gate or its structural components. Weakening of the structural components of the gates may also cause failure of seals, failure of gate alignment, or failure of quoin and miter blocks and a general deterioration of the lock gates.

3. CORROSION MITIGATION: Corrosion of the metallic components of the gates can be extensively reduced by the proper preparation and application of corrosion inhibiting coatings to the gate surfaces. In addition, corrosion of the gates can be further reduced, and the life of the applied coatings extended, by the installation of cathodic protection systems (CPSs).

a. Painting:

(1) Preparation of the ferrous surfaces of the gates and structural members, and the selection and application of protective coatings, should be accomplished in accordance with the requirements of UFGS-09965A, “Painting; Hydraulic Structures and Appurtenant Works.” The stringent requirements of the guide specification, including the Safety and Health Provisions detailed therein, should be adhered to.

(2) Ferrous surfaces of the gate structure should be cleaned to a grade approaching white metal grade in accordance with UFGS-09965A. The surface anchor pattern shall be consistent with the recommendations of the coating manufacturer. Quality control should be in accordance with the requirements of this guide specification, and the method and minimum thickness of application of the protective coatings specified therein should be adhered to. Proper surface preparation is essential for achieving a good coating life.

b. Impressed Current: Installation of a CPS utilizing sacrificial anodes is considered an inadequate method for cathodically protecting the Lock B miter gates. Impressed current cathodic protection should therefore be applied using the guidance of CW-16643.

(1) A separate impressed current CPS should be provided for each gate leaf. Each system should consist of a rectifier supplying protective current to anodes, which will distribute protective current to the gate structure. Cathodic protection should be installed on those portions of the gates submerged at normal pool levels. The faces of the gates should be protected to upper pool stages, except that the downstream face of the lower gates should be protected to the lower pool. Meters should be provided as part of the rectifier to monitor the CPS voltage and current.

(2) This navigation lock will be subject to flooding and floating debris; therefore, the CPS should be designed to permit for removal during periods of high water, and the anode cables and sausage-type anodes will require impact protection to prevent them from being damaged.

4. MAINTENANCE AND MONITORING: Maintenance and monitoring of the CPS (sacrificial or impressed current) are essential to ensure continuing corrosion protection. The areas of the lock gates to receive cathodic protection are those areas of the gates already stipulated in paragraph 3b(1). Monitoring and evaluations should be accomplished as follows:

a. The voltage and current readings of the rectifiers should be observed, monitored, and recorded daily. DC voltage and current data indicate that the rectifiers and CPS are working but do not guarantee that the system is properly optimized. Typical information on voltage and current data recordings is as follows:

GATE	VOLTS	AMPS
Upper - left leaf	14.5	0.3
Upper - right leaf	14.2	0.3
Lower - left leaf	11.4	0.6
Lower - right leaf	10.8	0.4

b. The evaluation of annual reference cell voltage data indicating the structure-to-electrolyte (lock-to-water) potential is the accepted method for determining the adequacy of corrosion protection provided by the CPS. Reference cell data are evaluated based on the design (anode locations), the voltage adjustments, and the adequacy of the test locations. Adjustments to the rectifier output can be made to improve the protective potentials applied to the gate leaves. Attached Table A-1 provides details on typical reference cell data.

(Name)

(Position)

TABLE A-1
(Impressed Current Installation)

RECTIFIER NO. 1
Upper Gate - Land Leaf - Upstream Side
Steel to Half-Cell Potentials*
Reports Control Symbol ENGW-E-7

Date of test: 1 Oct. 1991

Depth Below Water Surface mm	Pre-Protection			Current On			Current Off		
	Quoin End	Middle	Miter End	Quoin End	Middle	Miter End	Quoin End	Middle	Miter End
150	-0.500	-0.505	-0.495	-1.050	-1.000	-1.055	-0.655	-0.700	-0.650*
600	-0.500	-0.500	-0.500	-1.040	-1.030	-1.035	-0.700	-0.735	-0.705
1200	-0.500	-0.500	-0.500	-1.050	-1.085	-1.050	-0.825	-0.755	-0.815
1850	-0.500	-0.495	-0.495	-1.050	-1.100	-1.055	-0.855	-0.765	-0.850
2450	-0.495	-0.490	-0.490	-1.050	-1.085	-1.050	-0.865	-0.770	-0.850
3050	-0.490	-0.480	-0.485	-1.080	-1.110	-1.070	-0.880	-0.880	-0.850**
3650	-0.490	-0.480	-0.480	-1.070	-1.080	-1.060	-0.885	-0.880	-0.880
4250	-0.480	-0.479	-0.470	-1.070	-1.070	-1.065	-0.880	-0.885	-0.980
4900	-0.470	-0.464	-0.460	-1.000	-1.020	-1.030	-0.885	-0.890	-0.980
5500	-0.465	-0.455	-0.450	-1.000	-0.979	-1.050	-0.880	-0.885	-0.985
6100	-0.460	-0.445	-0.440	-0.950	-0.930	-1.000	-0.870	-0.875	-0.1075

Rectifier voltage = 2.10 volts
Rectifier current = 0.50 amps
Coarse tap position = L
Fine tap position = 2
Meter used 5 meg ohms/volt 2 volt scale
Half-cell 75 mm or less from lock steel
Resistance of circuit: E = IR
2.10 = .5R
R = 2.10/.5 = 4 ohms

NOTE: Include as many 600-mm (2-ft) increments as necessary to cover submerged depth of gate

* Unacceptable reading
** Acceptable reading

* All potential measurements are expressed in units of direct current (DC) volts with respect to a copper/copper sulfate half cell.