TECHNICAL SPECIAL PROVISION

FOR

NON-STRUCTURAL AND STRUCTURAL INTEGRAL PILE JACKET WITH SACRIFICIAL CATHODIC PROTECTION

Financial Project ID 429140-1-52-01, 429140-2-52-01 & 428267-1-52-01

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Date: April, 2014
SECTION 1000
NON-STRUCTURAL AND STRUCTURAL INTEGRAL PILE JACKET WITH SACRIFICIAL CATHODIC PROTECTION

T1000-1 Description
T1000-1.1 General: Install non-structural and structural integral pile jackets with cathodic protection on the piles for bridges 900003 and 90074 at locations as specified in the plans. All requirements of Special Provision 457 shall be met.

T1000-1.2 Quantities: Due to the nature of the deterioration present on these bridges, the Engineer may add or delete quantities beyond the limits per Section 4-3 of the Standard Specifications with no adjustment to the contract unit prices.

T1000 – 1.3 Continuity: Verify and provide electrical continuity of the reinforcing steel, prestressing strands, or any other steel components inside the piles. On piles where pile splices are detected, check and provide continuity between both pile sections. Due to the elevation on some of the piles, continuity checks and corrections, and negative connection installations will be limited to periods of low tide. If no portion of the pile is exposed during low tide, continuity testing and corrections shall be underwater.

T1000-1.4 Submittals: All submittals shall be in accordance with Standard Specification Section 5.

Submit shop drawings and material certifications, including but not limited to, wiring, ring connectors, crimping tool, splice insulation, corrosion inhibitors and as required in Special Provision 457.

Submit chemical composition and data sheet for the zinc mesh anode and the bulk zinc anode.

T1000-1.5 Phasing of Work: As determined by the Engineer, repairs shall be phased where the structural integrity of the pile will be affected due to the amount of concrete removal. Shop drawings shall be submitted to the Engineer showing how the repair is to be done insuring the structural integrity of the structure for approval prior to starting the repair. All shop drawing and backup calculation shall be signed and sealed by a Florida professional engineer.

T1000-1.6 Deterioration Survey and Report:
T1000-1.6.1 Deterioration Survey: A visible and sounding survey of the piles for bridges 900003 and 900074 shall be performed to locate all deteriorated concrete areas on the pilings and to verify type of jacket required and that the specified lengths will encompass all major deficiencies. All deficiencies, cracked, spalled and delaminated areas identified shall be marked or otherwise delineated. The limits shall be verified and modified as directed by the Engineer. Record the type and length of jacket for approval by the Engineer. The survey shall be performed in the presence of the Engineer prior to commencing any work.

T1000-1.6.2 Report: After the deterioration survey has been done a Pile Deterioration Survey Report shall be prepared identifying the areas, type and limit of each deterioration found and an estimated length of pile jacket required to encompass all major deficiencies and type of jacket to be installed. If length of the jacket, as specified on the plans, is insufficient to encompass the major deficiencies it shall be adjusted as required to ensure that all major
deficiencies are included within the pile jacket. Minimum length of pile jacket shall be as shown on the plans. The report shall be formatted to indicate precise location and limit of each repair, estimated length of pile jacket for each pile. This document will be used by the Engineer for preparing the authorization to proceed and by the Contractor to track quantities. The Contractor shall update the report on a monthly basis to indicate actual length of pile jackets installed and remaining budget available to continue with the work.

T1000-1.8 Authorization to Proceed with Installation of the Pile Jackets: Installation of the pile jackets shall not start until after the Pile Deterioration Survey and Report has been completed and approved by the Engineer. Upon request the Engineer will consider partially approving the Pile Deterioration Survey and Report when the Engineer determines it in the best interest of the Department. The Contractor will be expected to begin work within 14 calendar days following issuance of the authorization to proceed with work. Pile jacket installation performed after exhaustion of budget due to Contractor’s failure to track quantities will be at the Contractor’s expense.

T1000-1.9 Mean Low Water (MLW) and Mean High Water (MHW): The Contractor shall be responsible for determining the MLW and MHW elevations prior to start of construction.

T1000-2 Quality Assurance /Quality Control
T1000-2.1 Quality Assurance: The Contractor shall secure the services of a National Association of Corrosion Engineers (NACE) certified Cathodic Protection Specialist (CPS) with a minimum of two years of verifiable experience in the field of cathodic protection on concrete and a minimum of five years of experience in the field of corrosion control on concrete structures.

As an alternate, the CPS may be either:
  i) Cathodic protection practitioner with a minimum of 10 years of experience in the field of field of cathodic protection on concrete and 15 years of verifiable experience in the field of corrosion control on marine concrete structures.
  ii) Licensed professional engineer with similar requirements as for the NACE certified specialist.

The CPS shall be independent of the metalizing or construction operation.

Submit in writing the qualifications of the individual selected for the Engineer’s approval. Acceptance of the CPS shall be subject to approval of the Engineer.

T1000-2.2 Quality Control: Submit a Quality Control/Quality Assurance (QC/QA) plan, which has been reviewed and approved by the CPS, to the Department for approval prior to commencing the system installation. QC/QA Plan shall include tasks to be executed by the Contractor, as well as those executed by the CPS. It is recommended that the Contractor discuss the intended installation schedule with the CPS prior to preparing his bid to assure that the intended schedule does not conflict with the QC/QA plan.

T1000-2.3 Quality Assurance Tasks: The minimum quality assurance tasks are as follows:
  • Personally supervise every phase of the installation of the cathodic protection system.
Perform all the continuity testing, check all the continuity corrections, and perform the initial energizing on all the piles including: anode-cathode resistance, current, static, and energized potential measurements.

Conduct a minimum of one Quality Assurance visit to the jobsite per month and update the Engineer on the status and quality of the work, both verbally and in writing, on a monthly basis.

Check for shorts between the anode and every steel component in the piles and notify the contractor for correction(s) as necessary.

T1000-2.4 Certification Statement: The Contractor shall submit from the CPS original final construction reports to the Department after completion of the project. The report shall include the following statement signed and notarized by the CPS:

“I hereby certify that the facilities constructed under Financial Project Number 428267-1-52-01 have been completed and are functionally complete. I further certify that construction on these facilities has preceded substantially in accordance with the contract plans and specifications or that any deviations which are noted below will not prevent the system from function in compliance with the intent of the contract when properly operated and maintained. These determinations have been based upon my on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with the contract plans and modifications.”

T1000-3 Materials

T1000-3.1 General: All materials shall be per Special Provision 457 and per this Technical Special Provision

T1000-3.2 Welded Wire Reinforcement: Galvanized welded wire reinforcement (WWR) shall conform to ASTM Specification A1064.

T1000-3.3 Expanded Zinc Mesh Anode Jacket: Zinc mesh anode attached inside the jacket shall be an expanded zinc mesh conforming to ASTM International B69 with the following metal composition:

- Lead (Pb) 0.003 % weight maximum
- Iron (Fe) 0.001% weight maximum
- Cadmium (Cd) 0.001 % weight maximum
- Copper (Cu) 0.7 - 0.9% weight maximum
- Aluminum (Al) 0.001% weight maximum
- Titanium (Ti) 0.001 % weight maximum
- Magnesium (Mg) 0.001 % weight maximum
- Nickel (Ni) 0.001 % weight maximum
- Tin (Sn) 0.001 % weight maximum
- Zinc (Zn) balance

Additionally, the mesh anode shall have the following physical properties:

- Electrical conductivity = 28% minimum
- Solid zinc density = 0.26 pounds per cubic inch
• Weight of expanded mesh = 1.6 pounds per square foot minimum
• Open area of expanded mesh = 53% (density)
• Solid zinc sheet thickness = 3/32 inches

The expanded mesh anode shall also conform to the following nominal geometry to allow proper grout encapsulation:
• 0.5 inches Hex pattern
• 0.125 inches Strand width in the short direction
• 0.500 inches Strand width in the long direction
• 0.320 inches Short opening
• 0.750 inches Long opening

The expanded zinc mesh anode shall be provided with two (2) No. 6 AWG HMWPE copper strand wire connection wires, which shall extend to the designated terminal box.

**T1000-3.4 Bulk Zinc Anode:** Each bulk zinc anode shall be a 50 pound nominal weight minimum, 99% pure zinc anode (hull type anode) with a steel strap core, conforming to ASTM B-418. The steel strap shall be hot dip galvanized with sufficient thickness to be welded to the supporting channel. A hole shall be drilled at each end of the strap for mounting. Such hole shall be fabricated prior to galvanizing.

**T1000-3.5 Chlorides:** Filler material shall not contain chlorides in excess of 0.4 pounds of chlorides per cubic yard of filler after placement.

**T1000-3.6 PVC Components:** All PVC components shall be schedule 80, sunlight resistant. All hardware for the installation of the PVC conduits and terminal boxes shall be 316 stainless steel.

**T1000-4 Construction Method**

**T1000-4.1 Surface Preparation:** Perform surface preparation in accordance with Special Provision 457.

Remove all marine growth from the pilings. This may be achieved by sandblasting, hydroblasting or other methods as approved by the Engineer.

Unsound concrete extending a depth of one (1”) inches or more beyond the strands for 2 strands on any one face or a total of 5 strands or more than 20% of the cross section area has deteriorated the Engineer shall be notified at once and a revised repair procedure shall be prepared for the Engineers approval.

**T1000-4.2 Spalls Outside Jacket Limits:** All major deficiencies shall be encompassed within the jacket limits. Minor deficiencies may be required to be repaired outside the jacket limits as directed by the Engineer. A QPL approved latex modified concrete or underwater repair mortar shall be used for deficiencies outside the limits of the cathodic protection jackets as required.

**T1000-4.3 Cathodic Protection Pile Jacket Installation:** The cathodic protection pile jackets shall be installed as shown on the plans, Technical Special Provision 457, and this Technical Special Provision.
Following placement of the forms, but prior to placement of the stiff-backs, temporarily protect the forms by wrapping a thin plastic film between the forms and the stiff-backs. After removal of stiff-backs, a 1.75-inch diameter access hole shall be core-drilled through the jacket to the depth of the pile on one face of the pile at an elevation of 6-inches above mean high water or as shown on the drawings. The inside surface of the access hole (except for the pile surface) shall be PVC shielded or epoxy coated after the operation is completed.

All connection lead wires shall be routed to the terminal box located above the pile jacket as shown in the plans, and shall be color coded. The negative lead wires shall be black and the positive lead wires shall be red. The lengths of the lead wires shall be such that they can be routed to the terminal box without splices.

All connections of the lead wires to the terminals in the terminal box shall be made with ferrule ring connectors crimped with a proper crimp tool. After the lead wires are connected by the CPS, install an approved insulating material to prevent future corrosion.

**T1000-4.4 Bulk Zinc Anode Installation:** A 50 bulk (nominal) zinc anode shall be installed with each cathodic protection integral pile jacket as shown in the plans prior to placement of the filler material in the pile jacket. The anode shall be installed in such a way that allows the entire length of the anode to be in contact with the surface of the pile. The bulk anode and hardware will make up one anode assembly. The anode shall be clamped onto the pile using galvanized hardware.

A No. 6 AWG HMWPE copper strand wire shall be connected to the anode via a 3/8-inch diameter steel bar welded to the anode strap. The No. 6 AWG wire shall be brazed to the bar. The bar-wire connection shall be permanently encased in a 1.25-inch diameter by 10-inch long PVC pipe filled with epoxy. All required fabrication shall be done prior to the anode installation.

Precautions shall be taken to protect the wire insulation from heat during the welding and brazing operation and to protect the wire insulation and splice during anode installation.

A 1 ¼-inch diameter PVC pipe shall be used to insulate the splice and shall connect to a ¾-inch pipe. The ¼-inch pipe shall be inserted approximately 2-inches inside the bottom of the cathodic protection pile jacket unless otherwise shown. No additional conduit shall be used on the portion of the wire inside the pile jacket. Inside the pile jacket, the wire shall be routed upward along the closest corner and positioned between the pile jacket form and the zinc mesh anode. At the top of the jacket, the wire shall be routed in conduit to the PVC connection box. In the connection box the bulk anode wire shall be connected to the zinc mesh anode wires and the reinforcing steel connection wires as shown on the plans. Temporary conduit for the purpose of routing the wire to top of the jacket may be permitted as approved by the Engineer.

Shop drawings shall be submitted for the bulk zinc anode installation and attachment to the pile.

**T1000-4.5 Negative Connections:** Provide redundant negative connections for new and existing reinforcement on piles receiving cathodic protection. The redundant electrical negative system shall consist of #10 AWG XHHW copper strand wires connected by brazing for a minimum length of 1-inch to the spiral tie and structural reinforcement cage as called for below.
For non-structural pile jacket the redundant electrical negative system shall consist of 2-#10 wires brazed to different areas of the existing spiral tie in the pile and brazed to two different locations on the weld wire fabric.

For structural pile jacket the redundant electrical negative system shall consist of 4-#10 wires, two brazed to different areas of the existing spiral tie in the pile and two brazed to two different bars in the structural reinforcement cage.

The wire to the spiral tie and structural reinforcement cage connections shall receive a coat of 100% solids, non-conductive epoxy such that no wire or brazing material will be in contact with the concrete when patching.

Precautions shall be taken to protect the wire insulation from heat during the brazing operation.

Excavation to expose the spiral ties shall be kept to a minimum. Routing wires outside the excavation to the terminal box inside the pile jacket to the conduit attached to the terminal box. The excavation shall not be filled until the continuity has been verified between the wire(s) to spiral tie connections.

**T1000-4.6 Terminal Box:** The terminal box to house the anode to steel connections shall be 5-inches x 5-inches x 3-inches (minimum) or other suitable size that will accommodate the wires and monitoring devices and shall have a weather tight cover.

The box shall be fabricated to accept a 5/16- inch diameter stainless steel bolt which will connect the system wires inside the box or two, ¼-inch bolts when using a shunt. The bolt(s) shall extend outside the box 1 inch.

Elevation of the connection box shall be maintained constant throughout the project.

**T1000-4.7 Continuity Corrections:** Any connection that tests discontinuous shall be repaired by at no extra cost to the department. After connection is approved satisfactory by the CPS, the excavation shall be filled with an approved grout (above water) or epoxy mortar (if below water). Connections shall not be left exposed longer than 14 days.

Prior to installing the pile jackets, the CPS shall perform an electrical continuity test between all strands, spiral ties, and any other steel components on all the piles receiving cathodic protection. Continuity of the prestressing steel and tie spirals shall be provided by resistance welding or other approved method(s). On piles where a pile splice is detected before, during or after clean-up, continuity shall be tested, and provided between both pile sections if found discontinuous. Such tests and any necessary continuity corrections test shall be performed and certified correct by the CPS.

Strands for continuity test shall be exposed by drilling a ¾-inch diameter hole to each strand in the concrete and measuring inter-strand voltage using a high impedance voltmeter. Holes to access the strands shall be staggered at 1-foot intervals at a minimum elevation of 2-feet above high tide. Where continuity correction is required, additional concrete excavation will be necessary. Size of continuity correction excavation shall kept to a minimum and be approved by the Engineer.
On piles where more than two discontinuous strands are found per face, a 2-inch wide groove shall be saw cut at an elevation in the upper portion of the jackets. Continuity shall then be provided to all strands at the groove.

All hole(s) or excavation for continuity testing performed outside or inside the jacket limits shall be filled with an approved grout prior to installing the jacket and shall not be exposed for more than 14 days.

Care shall be taken to avoid cutting any of the strands or spiral ties during the drilling and/or saw cutting operation.

Continuity tests shall be performed by the CPS prior to removing any concrete for continuity corrections. Continuity shall be provided by resistance welding two continuous solid steel wires to each strand requiring continuity correction inside the excavation. Continuity shall be re-tested on all strands after this operation is completed. All welds shall be approved satisfactory by the Engineer.

Continuity welds shall receive a coat of 100% solids, non-conductive epoxy such that no welded wire shall be in contact with the concrete when patching.

Intended resistance welding equipment and procedure shall be included and submitted for approval in the shop drawings prior to performing this work. Elevation for continuity correction excavations shall be no lower than 1 foot below the top of the jacket unless approved by the Engineer. The Contractor shall be responsible for determining the proper wire gauge and the resistance welder output for this operation. Final approval by the Engineer will be required.

**T1000-5 Energizing**

**T1000-5.1 Cathodic Protection Specialist Report:** The CPS, through the Contractor, shall submit a report to the Engineer detailing: continuity testing and correction, anode to steel resistance, energizing current and static and energized on and instant off potentials for each pile. Potentials shall be measured with a portable copper-copper (II) sulfate electrode (CSE) placed in the water and in the monitoring access hole. Submit tests results and initial energizing report for approval to the Department’s State Corrosion Engineer. The project shall not be considered complete until the report is satisfactorily approved.

**T1000-6 Acceptance Criteria**

No jackets with any of the anodes shorted to the reinforcement or misaligned will be accepted. All shorted jackets shall be removed and replaced by the Contractor at no additional cost to the Department. Jackets misaligned one inch or less may be accepted at a reduced price not to exceed 75% of the unit price as determined by the Engineer.

**T1000-7 Method of Measurement**

Measure as per Special Provision 457.

**T1000-8 Basis of Payment**

Price and Payment shall be as per Special Provision 457 and shall include the cost of quality control/quality assurance and the CPS services as described herein.

Payment for this work shall be included under Pay Item Number:

457-2-121 Cathodic Protection Integral Pile Jacket, Non-Structural, 16.1-30”, Galvanic System
457-2-221 Cathodic Protection Integral Pile Jacket, Structural, 16.1-30”, Galvanic System