SMALL WORKS BID NO. 20-SW02

ROCKY REACH C2 AND C7 THRUST BEARING SHOES REBABBITTING

EXHIBIT S

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SMALL WORKS BID NO. 20-SW02

EXHIBIT S

SPECIFICATIONS

ROCKY REACH UNITS C2 AND C7 THRUST BEARING SHOES REBABBITTING
(2 FULL SETS OF 16 SHOES)

1.0 SCOPE OF WORK

The Work covered in this Specification includes the furnishing of all labor, supervision, tools, equipment and materials required for the re-babbitting and machining of up to two (2) generator thrust bearing assemblies (16 shoes per assembly) for the Rocky Reach Hydroelectric Project. The District will determine the total quantity of shoes that require rebabbitting, based on inspections during disassembly. The Contractor shall clean the bearing shoe/base, perform receiving inspection, remove the existing babbitt, tin, re-pour with new babbitt, rough machine the babbitt surface, ultrasonically inspect the babbitt bond, machine the babbitt to final dimensions, perform the final inspections, and deliver the assembly back to the District.

2.0 REFERENCES

<table>
<thead>
<tr>
<th>AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)</th>
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<td>SNT-TC-1A</td>
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3.0 MATERIALS

3.1 All materials and components shall be of high quality, free from defects and imperfections, of recent manufacture, unused and suitable for the intended use. Unless otherwise specified, all materials and components shall conform to the latest specifications of the American Standards for Testing Materials (ASTM). All materials and components not manufactured by the Contractor shall be products of recognized reputable manufacturers.

3.2 The Contractor shall provide the District with a certificate of analysis of the babbitt alloy used under this contract. The babbitt sample(s) shall be taken at random from each active pot of the bearing pour and analyzed for chemical composition. These reports shall be submitted for District review immediately after analysis results are published. The District reserves the right to require an analysis of the babbitt by an independent testing laboratory. Such an analysis will be at the District’s expense unless the analysis shows that material does not meet the requirements of these Specifications, in which case the cost of such analysis shall be borne by the Contractor.

3.3 The material to be applied to the bearing shall be all new (not used) tin based babbitt metal complying with ASTM standard specification for White Metal Bearing Alloys B23, Grade 2:

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<th>Element</th>
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<tr>
<td>Tin</td>
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<tr>
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<td>Lead</td>
<td>0.35% max</td>
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<td>Copper</td>
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4.0 WORKMANSHIP

Workmanship shall be of first-class commercial quality and in accordance with the best modern shop practices. Care will be exercised so that any and all residual stresses will be minimized.

5.0 RECEIVING INSPECTION

The existing babbitt and tin shall be removed and the steel backing shall be sandblasted to clean metal and then a magnetic particle (MT) inspection performed. The Contractor shall further inspect the used bearing shoe with reference to Contract Drawing 381-C-976. Any conditions that do not conform to the Contract Drawing or Specifications shall be reported to the District in writing using a non-conformance report or Equal. If, in the opinion of the Contractor, work in addition to the standard re-babbitting and machining may be required or recommended in order to restore the bearing to the “as manufactured” condition, the Contractor shall submit for District review and approval, a proposal detailing the recommended corrective action, corresponding cost and impact to the delivery
schedule. All Contractor receiving inspection reports and proposals shall be submitted to the District no later than 7 days after the thrust bearing assembly is delivered to Contractor's shop.

6.0 **BABBITT REMOVAL**

6.1 The preferred method of old babbitt removal from the bearing shoe is via a machining operation. This method will be permitted if the shoe thickness, after machining, is not less than the original manufacturer’s dimension by more than 0.063”.

If the above criteria cannot be met, old babbitt removal by melting may be used. Proper care must be taken to avoid warping or introducing internal stresses into the bearing shoe. If this method is to be used, notification shall be made to the District prior to proceeding.

6.2 The bearing shoe shall be free of all foreign substances, such as oil and dirt, prior to any tinning operations.

6.3 Perform PT of base steel after removal of babbitt and tin to check for cracks. PT report to be sent to the District Project Manager for evaluation and disposition.

7.0 **FLUXING AND TINNING**

7.1 The tinning operation must be performed immediately following the cleaning operation.

7.2 The surface to be tinned shall be cleaned to bare metal and have a 125 - 500 μin Ra finish. Special care shall be taken to protect all holes and surfaces of the shoes not receiving babbitt.

7.3 The bearing shoes shall be free of all foreign substances, such as oil and dirt, prior to any tinning operations. The surfaces shall be provided with a tinning coat to ensure a tight bond between the base metal and the new babbitt. The tinning operation must be performed immediately following the cleaning operation.

7.4 The surface to be babbitted shall be visually examined to assure that the tinning solder has uniformly wetted the entire surface.

7.5 The bearings shall be babbitted immediately after the tinning and fluxing operations. If the bearing shoe temperature should fall below 475°F before babbitting it should be re-heated by submersion in the tin pot.
8.0 BABBITTING

8.1 The minimum bearing shoe temperature at the time of babbitting shall be 475°F.

8.2 The babbitt pot must be thoroughly stirred and the dross removed prior to pouring the sample and the production bearing.

8.3 The babbitt shall be cast in a steady, continuous and smooth flow. Procedure used must be equal to methods described in DOD-STD-2188(SH), Section 5.7.2. Metal spraying and gas welding (inert or other) of babbitt is prohibited.

8.4 The bearings shall be forced cooled immediately after babbitting in a manner to promote directional solidification from bond line to babbitt surface.

8.5 After rebabbitting the thrust bearing pads, each pad shall then be machined with grooves to the final diametrical dimension as shown on Contract Drawing 381-C-976. The finish of the machined babbitt bearing surface shall be 16 micro-inches or better. The finish of the oil grooves is shown on the Contract Drawing. The direction of machine tool travel shall be the same as that of the rotating shaft of the generator. When looking down from above, the generator rotates in a counterclockwise direction. The pads shall be checked for dimensional conformity and defects. If the pads are out of tolerance, notification shall be made to the District within 24 hours of identifying that the pads are out of tolerance. A procedure of corrections required shall be submitted to the District within 2 business days after notification to the District that the pads are out of tolerance. Contractor shall perform the necessary repairs at the Contractor’s expense. Finish dimensions and runout checks shall be made while the pads are still on the mill. All pockets and grooves shall be placed as shown on Contract Drawing 381-C-976. Oil groove radii and sharp edges shall be hand blended and de-burred. All non-babbitted surfaces and holes shall be thoroughly cleaned.

9.0 ULTRASONIC (UT) AND LIQUID PENETRANT (PT) INSPECTIONS

9.1 The Contractor shall conduct UT and PT inspections of the bearing babbitt bond following the procedures detailed below. The final inspection may be witnessed at the District’s discretion, by the District’s representative in the Contractor’s shop following the completion of all finish machining.

9.2 After babbitting, rough machine the new babbitt surface to a finish of 125 micro inch to provide an adequate surface for the preliminary ultrasonic testing.

9.3 Equipment

9.3.1 Search Unit
a. Frequency - All acceptance testing of the babbitt bond shall be performed with a 2.25 MHz or 5 MHz longitudinal wave crystal.
b. Diameter - Transducer diameter shall be between 1/4 inch and 1 inch.
c. Transducer gloves or delay lines shall be made of Lucite or other materials with similar sonic properties.

9.3.2 Couplants used for testing shall be either lightweight oil or glycerin, the viscosity of which is not more than SAE 30 oil.

9.3.3 Reference Blocks

a. “Reference blocks" shall consist of a soundly babbitted steel block with a scanning surface and babbitt thickness representative of the pads tested. The block shall be used to set the sensitivity of the instrument. A reference block with artificially unbonded areas shall be furnished for comparison of indications for areas showing bond and lack of bond.
b. Test sensitivity shall be such that the babbitt to base material interface is readily identified on the CRT. Details of sensitivity calibration and determination of bonded and unbonded areas shall be defined in the UT procedure.
c. Reference blocks shall be kept available for frequent reference during actual testing.

9.4 Procedure

The entire babbitt surface of each bearing pad shall be scanned using overlapping scan paths by at least 20 percent of the effective transducer width. Scanning rates shall not exceed 3 inches per second. Unbonded babbitt areas will result in indications of multiple reflections on the screen, accompanied by a partial (at least 50 percent) or complete (100 percent) loss of back reflection. Areas over temperature sensor grooves or dovetail grooves need not be UT examined. All unbonded babbitted areas shall be carefully scanned to determine their configuration. The outside edges of all unbonded areas shall be marked on the surface of the Babbitt.

9.5 Acceptance Standards

9.5.1 The babbitt bond shall be ultrasonically inspected and accepted in accordance with DOD-STD-2183(SH), Section 5.4.1., with the exception of the following:

a) Zone A Requirement: Total unbonded area shall not exceed 5 percent of the area of Zone A (per bearing segment).
b) Zone C Requirement: Total unbonded area shall not exceed 10 percent of the area of Zone C (per bearing segment).
9.5.2 After all the machining is completed, the final UT and PT inspections shall be performed. UT requirements are as stated in Section 9.0 above. The PT exam shall be performed along the entire bond line between the bearing shoe base metal and the babbitt metal, on all bearing shoes. PT indications longer than 3/8” are rejectable. Indications smaller than 3/8” are acceptable if it does not show up on the UT.

9.5.3 The personnel performing the inspections shall be certified to Level II or Level III of the American Society for Non-Destructive Testing in accordance with SNT-TC-1A or equivalent which is regularly engaged in nondestructive testing. A copy of the inspector’s credentials must accompany the NDT report.

9.5.4 If repairs are required in the babbitt surface, a repair procedure shall be submitted, if not included in the rebabbitting procedure. Puddling will be acceptable for small areas on the surface, but not to correct the lack of bond between the babbitt and pad. The babbitt material shall be free of cracks, blow holes, and shrink pockets, have a tight bond to the bearing pad, and be 100% free from surface porosity.

9.6 Inspection Report

A certified written report from the certified technician shall be submitted prior to shipping to the District for final approval. The report shall include a complete description of the PT and UT procedures used, equipment used, a mapping of the areas tested, pad number, and interpretation of results. The report shall specifically address areas of lack of bond between the babbitt and the pad and their accumulated total surface area relative to the total babbitt surface area. The report shall also address the total percentage of porosity and any cracking that is found.

10.0 MACHINING AND FINISHING

10.1 Finish machine the babbitted surface per Contract Drawing 381-C-976.

10.2 Machine oil distribution grooves and the oil holes per Contract Drawing 381-C-976. Oil grooves shall be hand blended and sharp edges deburred.

10.3 Outer and inner bearing surfaces, water and grease passages, drain slots and all drilled and/or tapped holes to be free of tin, babbitt, or other foreign material. Corroded and rusted surfaces, water and grease passages, holes, tapped holes etc. shall be purged, wire brushed and/or sanded to clean metal.

10.4 Babbitt Surface Contact. After rebabbitting and final machining, the contact area of the babbitt surface shall be checked on each shoe to determine percent contact area using a certified granite surface or Approved equivalent. A bluing process
shall be used. The surface flatness shall have a minimum of 85% contact. The surface shall be scraped, if necessary, to achieve 85% contact.

11.0 PAINTING

11.1 The babbitted and finished surfaces shall be coated with a suitable corrosion preventative (i.e. Cosmoline).

11.2 All unfinished surfaces shall be coated with 14-18 mils (dry film thickness) of black Carboline Bitumastic 300M or International Intertuf 708. Surface preparation shall be in accordance to coating manufacturer’s recommendations for full immersion applications. All other coating manufacturers’ recommendations shall also be followed.

11.3 Adhesion Testing

a) Test coating system for proper adhesion to the base metal in accordance with ASTM D3359, Test Method A - Standard Test Methods for Measuring Adhesion by Tape Test or D4541-Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers. Contractor shall test a minimum of one location on a minimum of four (4) thrust shoes.

b) There shall be no adhesion loss at each location of less than a grade 3A as defined in ASTM D3359. Rejected and tested areas shall be corrected per the coating manufacturers’ requirements.

12.0 PROJECT ACCEPTANCE

If the bearing does not meet these Specifications, a Contractor issued Nonconformance Report (NCR) (see Attachment A) which states the Contractor’s recommended disposition shall be submitted for District review. Project acceptance requires that:

1. All NCRs shall be Approved by District and reconciled,
2. Thrust bearing assembly shall meet all the requirements of this Specification and Contract Drawings.
3. Thrust bearing assembly Work is complete in every detail.

13.0 QA/QC REQUIREMENTS

13.1 The District reserves the right to witness/inspect/photograph any portion(s) of the Work. Additional inspections and/or measurements by Contractor that may be requested by the District shall be performed at no additional charge. Any inspection by the District or waivers thereof, shall not relieve the Contractor of responsibility for meeting all requirements of these Specifications. Any variations
from Specifications shall be promptly reported to the District. The Contractor may utilize its own or any other inspection facilities and/or services as Approved by the District.

All test equipment and inspection facilities shall meet the requirements of DOD-STD-2183(SH), Section 5.1.

13.2 The Contractor shall maintain a record of each inspection. As a minimum, copies of the following documents are to be maintained at the Contractor’s facilities for a period of six (6) years and must be made available to the District upon request.

a) Receiving inspection report.
b) Certificate of analysis of babbitt alloy used.
c) Certificate of conformance to verify satisfactory ultrasonic testing with a plot of any unbonded areas.
d) Record of Babbitt surface finish.
e) Written warranty. Warranty shall cover parts, material, workmanship and labor for no less than 12 months and shall begin the date the project is accepted by the District.

The documentation shall show the Contract # (20-SW02), date, type of inspection, description of inspection procedure, the inspector’s name and signature, the inspector’s credentials and the type of equipment used. All inspection reports are to be submitted to the District via email promptly after the inspections are completed. Hardcopies of all project records shall be submitted to the District’s representative at the time of the final inspection.

13.3 The District intends to conduct an inspection at the Contractor’s facility following the completion of all the finish machining for purposes of verifying the Specification babbitt bonding and finish machine requirements. The Contractor shall notify the District as early as possible, but at least seven (7) days in advance, of the readiness of the bearing for the final inspection. Inspections may include:

- UT and PT babbitt bond inspection
- Surface finish verification
- Dimensional verifications
- Paint thickness verification
- Paint adhesion testing verification

The Contractor shall provide assistance to the District as requested and make available for the District’s use instruments such as micrometers, calipers, etc.

13.4 The District will determine the acceptability of the bonds based on the acceptance standards listed in these Specifications. Any rejected areas shall be repaired according to instructions provided by the District. Any rebabbitting shall be re-
inspected after repairs have been completed. Rebabbitting shall not be conducted without the approval of the District.

14.0 PACKAGING/SHIPPING REQUIREMENTS

14.1 As outlined in Specific Requirements of the Contract Documents, return shipping by the Contractor is included as part of this Contract. The Contractor shall be responsible for the following:

a) Proper protective crating and delivery of the bearing(s) to:

   Public Utility District No. 1 of Chelan County
   Rocky Reach Dam
   Riverside Warehouse
   5000 Highway 97A North
   Wenatchee, WA 98801
   ATTN: Mitch Clark

b) The payment of all shipping charges, etc.

c) Acquiring any and all shipping permits, etc. as required.

14.2 The bearing shall not be shipped from the Contractor’s facilities until the District has inspected the shoes following the finish machining at the Contractor’s facilities and has issued a shipping release form.

When actual shipment has been made, the Contractor shall notify the Project Engineer in writing.

14.3 The Contractor shall be responsible for properly packaging all items shipped from its premises. The Contractor shall prepare the bearing for shipment from its shop in such a manner that it is protected from damage during shipment and shall be responsible for, and make good, damage resulting from improper preparation.

The bearings will be placed in existing District owned wooden crates for delivery to Contractor. The Contractor is responsible to ensure that the crates are adequate to protect the bearing during return shipment. If not, the Contractor shall modify the crates or provide crates adequate to protect the bearings during shipment. If the District’s crates are damaged during bearing shipment from ship, those shall be repaired or replaced, free of charge, to the District’s satisfaction. Replacement wooden crates (if needed) shall be built in such a way as to protect the bearings from any damage during shipment. Crates shall be clearly marked with the District’s delivery address, Contract number, and weight.
15.0 DISTRICT CONTACT

All inspection reports and technical inquiries are to be forwarded to:

Public Utility District No. 1 of Chelan County
P.O. Box 1231
Wenatchee, WA 98807
ATTN: Mitch Clark – RR Dam
   Phone: 509-661-4794
   Email: Mitchell.Clark@chelanpud.org
## 16.0 ATTACHMENT A

### Sample Nonconformance Report

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### Project: Rocky Reach Units C2 and C7 Thrust Bearing Shoes Rabbitting

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### Disposition Assigned To: | Date: | Condition Details Approved: | Date:

### Nonconformance responsibility: | Contractor/Vendor | CPUD | Other

### Action:

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### Disposition Details:

**THIS DOCUMENT IS FOR DIRECTION ONLY AND DOES NOT AUTHORIZE ANY INCREASE OR DECREASE IN THE CONTRACT VALUE, NOR CHANGE THE COMPLETION TIME OF THE PROJECT.**

### Disposition by: | Date:

### Disposition Details Approved: | Approved | Unapproved

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### CPUD Engineer: ____________________________ | Date: _____________________

### QA Engineer: ____________________________ | Date: _____________________

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### END OF EXHIBIT S