Kings River Conservation District
Jeff L. Taylor Pine Flat Power Plant

REQUEST FOR PROPOSAL (RFP)

Hitachi Hydroelectric Turbine & Generator Upgrade / Repair

REVISION 2

March 28, 2012
1. **General Project Description**

Kings River Conservation District (KRCD or District) owns and operates three (3) Hitachi hydroelectric / Francis turbine units at Pine Flat Dam. Each unit’s service hours are as follows:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Manufacture</th>
<th>Commission Date</th>
<th>Run Time Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1983</td>
<td>Since Commissioning up to 2/13/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Run Hours</td>
</tr>
<tr>
<td>1</td>
<td>1982</td>
<td>1983</td>
<td>92,643</td>
</tr>
<tr>
<td>2</td>
<td>1982</td>
<td>1983</td>
<td>97,868</td>
</tr>
<tr>
<td>3</td>
<td>1982</td>
<td>1983</td>
<td>89,276</td>
</tr>
</tbody>
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* 1 Start = 10 Hours of Run Hours (RH)

Based on the age of the units, there are four (4) projects that the District would like to receive budgetary cost to perform – a brief summary of each is as follows:

- a. Provide the required spares to perform a complete rewind of the existing units. – *(see - “Attachment A”)*
- b. Provide a cost estimate to perform the field labor portion of the complete unit disassembly, inspection, cleaning, stator rewind, rotor pole refurbishment and unit reassembly project along with all required field testing. – *(see - “Attachment B”)*
- c. Provide a cost estimate to perform a rotor removal only, rotor pole refurbishment, winding inspection and reassembly. – *(see - “Attachment C”)*
- d. Provide a cost estimate to perform weld repair of installed high head runners. – *(see - “Attachment D”)*

Depending on water years, the plan would be to perform these services on each unit over a 3 year term. Based on current test data, the sequential evolution would be Unit 2, Unit 1 and then Unit 3. The selected contractor for services b, c and d above, will provide a Project Manager for KRCD to ensure that all work scope is properly prepared, planned and executed through the selected process.

2. **Tie-In Points**

None noted at this time

3. **Physical On-Site / Off-Site Work Scope**

Attachments B – D has a general description of the onsite / offsite activities necessary to complete this project. This description does not reflect a comprehensive list of all activities for completion of the project. It does not reflect the required sequence of installation. The design deliverables will demonstrate the specific scope of work and
should be followed. The OEM instructions will need to be followed and adhered to at all time.

The Contractor will supply all materials necessary for all fabrication. Contractor will provide daily / weekly updates of the project status. Binders will be kept for all QA/QC documentation and made part of the final report to KRCD prior to invoice final payment.

Field verification of all dimensions must be accomplished by the Contractor prior to fabrication of generator requested coils and poles.

4. Crane Work:

KRCD has an installed 150 TON bridge crane at the project location. The crane is maintained on a routine basis and all current certifications will be made available to contractor. All needed lifting gear to remove the required generator / turbine parts will be certified prior to the project start. Contractor will provide a qualified crane operator to perform all lifts pertaining to the generator. Proof of qualification will be provided to KRCD prior to any use of the crane.

5. Onsite Quality Assurance / Quality Control Specifications:

All work at the site level shall follow all prudent industry guidelines / and OEM specifications. Best management practices will be required at all times during the work process. All readings needed, prior to teardown shall be properly documented, for example shaft run out, air gap measurements, shaft alignment, labeling / match marking verification – this is just a general list of items and not to be limited to these items only.

All required torque specifications shall be adhered to and documented during the rebuild process, verification and sign off by contractor’s supervisor / manager shall be provided.

6. Design Deliverables Summary (to be supplied to contractor)

*Structural* deliverables include: Issuing General Notes Drawing, Elevations Drawing, and Sections and Detail Drawings.

*Mechanical* deliverables include: Issuing Arrangement and Elevations Drawing, and Mechanical Specifications.

*Electrical* deliverables include: Design Specifications.

*OEM Manuals* deliverables include: A complete set will be provided to the selected bidder
7. **Construction Coordination**

KRCD will provide an onsite manager to assist in coordinating activities of the General Contractor for the duration of the project.

8. **Asbestos Management**

Due to the vintage of the generating units, asbestos was utilized during the manufacturing process as an insulator within the coils, poles and stator split line joints. The rewind process will require an onsite abatement process pertaining to the stator coils and the rotor poles will need to be abated during the factory level teardown and rebuild process.

The stator split line joints have also been identified as an area that contains asbestos – the District would like to have options presented in the responses pertaining to this as follows, do we?:

- Break the stator joints apart and abate the asbestos, or;
- Leave the asbestos in these locations and seal the joint, or;
- No action is needed if the joint is not disturbed

The selected contractor will need to subcontract with a certified contractor to perform this work and to ensure that all hazardous materials are properly abated and disposed of per all Federal / State regulations. Credential of certified subcontractor will need to be provided to the District. See attached diagram of locations -

9. **Site Conditions**

The Contractor shall be in full compliance with the safety requirements mandated by Federal, State and local authorities having jurisdiction at the project site. In addition, the Contractor shall comply with the safety requirements of KRCD. The Contractor shall ensure all personnel are so indoctrinated and shall ensure that their employees and the employees of their subcontractors are provided the necessary personnel protective equipment (hard-hat, safety glasses, steel toed safety shoes, fall protection, hearing protection and others). Personnel reporting for work not properly attired or without the necessary personnel protective equipment shall be sent off site, the Contractor shall have no claim if personnel are turned away.

The Contractor shall provide all the safeguards necessary to protect their employees and the employees of their subcontractors, or other subcontractors, and KRCD personnel as a result of their work activities. This includes, but is not limited to, protection of existing facilities, work in progress, equipment, and property. The Contractor shall provide and maintain all necessary handrails, fall protection, floor covers and the like as a result of their work. The Contractor shall replace any barricades, temporary protection, floor covers and the like, removed to facilitate
Contractor’s work immediately upon completion of the work or daily which ever occurs first. At no time will the Contractor leave barricades, floor covers, or any other safety hazard situation unprotected or unattended.

The Contractor is responsible for the actions of their employees and their subcontractor’s employees. The employees are restricted to the Contractor’s immediate work area and are not authorized to utilize or enter any of KRCD’s facilities unless authorized in writing by KRCD Management. Work, which must be accomplished within KRCD facilities, shall be planned and scheduled a minimum of seven days in advance.

Tie-in work or demolition work affecting KRCD’s “in use” facilities shall be accomplished with a minimum impact to KRCD’s operations. Work shall be completed in a smooth continuous operation that results in completion of the work with minimum interference to KRCD. Clean up is required prior to leaving the work area, on a daily basis.

The Contractor shall protect existing finished surfaces and materials from damage and shall repair or replace any damage because of Contractor’s work.

The contractor shall obtain permission from site management before storing materials outside of the contractor staging area, including the warehouse.

Eating and smoking are permitted in the contractor break area. Chewing gum and tobacco are permitted with the condition that they are put into the mouth before leaving the break area and there is no spitting in the production area. Personnel found in violation of the requirements are subject to immediate removal from the job site. The use of glass bottles or containers is prohibited.

KRCD demands continuous cleanup. The Contractor shall maintain their work area in a neat and clean manner. No debris, trash, and the like will be tolerated. The Contractor shall sweep and/or clean up prior to ending each shift. Contractor is responsible for the disposal of all major debris including, but not limited to, concrete spoils, scrap materials, demolition residue, crating and the like. KRCD reserves sole rights in determining the acceptability of cleanliness, failure on the part of the Contractor to maintain the cleanliness required will result in KRCD unilaterally performing the cleanup and deducting the costs from the Contractor’s progress payment. Costs will be determined on an actual cost basis.

The Contractor personnel shall be qualified to perform their assigned tasks. Contractor shall submit objective evidence that personnel are qualified where such evidence is readily available through qualifying agencies. Examples of personnel having objective qualifications included are generator winders, welders, operators, safety personnel, personnel identified by the Contractor as the “assigned competent person”.

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There shall be a designated supervisor on the site at all times, when work is being performed. The supervisor’s name should be given to KRCD, in writing, prior to the project being started. No work should be performed without this supervisor being present on site, unless agreed to by the KRCD Manager.

The Contractor is to make all employees aware of the dangers of working in a power plant and to be aware of plant traffic, while walking the site, during the execution of their work.

The contractor will be responsible for the safety and conduct of all the contractor’s employees and subcontractors. This includes the reporting of all contract and subcontract hours worked to the KRCD manager. Safety inspections will be conducted routinely by KRCD management or designated employee and any violations will be dealt with immediately. The contractor will be responsible for reporting all incidents to the District as proscribed in the construction safety plan.

The Contractor will be provided space to place a small change trailer, a lay-down area for material, and space for a small fabrication area. These areas must be kept clean and in order throughout the duration of the project.

10. Acknowledgement of Receipt of RFP

Please provide acknowledgement of receipt of RFP and intention to participate by either email or FAX to:

Jon Grilione, Buyer  
FAX - 559.787.2021  
Email – jgrilione@krcd.org

11. Proposal Due Date

All proposals need to be submitted by 1:00PM PST on Monday, 11 June 2012

12. Agreement by Proposing Author

By submitting a proposal, each vendor thereby agrees:

a) That the vendor's quotation will not be withdrawn after the time fixed for the opening of the Proposals and before Monday, 11 June 2012.

b) Should the vendor's quotation be accepted, the vendor will execute, within a reasonable time after receipt of written notice of such acceptance, an agreement with KRCD.
c) KRCD reserves the right to reject any and all Proposals, to call for new proposals, to waive an irregularity in any quotation and to make an award, in whole or in part, on either a fixed-price or adjusted price basis to one or more prospective vendors.

d) The acceptance of the quotation will depend upon compliance to details of the vendor requirements, price, specifications and drawings, and other factors.

e) All proposals will be valid for 60 days upon receipt

13. Alternate Proposal

Alternative proposals are encouraged, and will be accepted under the following conditions:

a) The vendor must first complete, and submit, a quotation that meets all the requirements and specifications indicated herein.

b) Changes or additions to the project specifications and scope listed will be entertained if:
   1. The proposed changes meet or exceed the specified requirements indicated in requested quotation, and
   2. The vendor provides a narrative explaining the reasoning for the changes and delineates the differences between the standard quotation and the alternative.

14. Submitting Proposals

Proposals may be sent via Email, fax or overnight mail to:

Kings River Conservation District
C/o Jon Grilione, Buyer
4886 E. Jensen Ave
Fresno, CA 93725

Office - 559.787.2577 ext. 3104
FAX - 559.787.2021
Email – jgrilione@krcd.org

15. Project Team Resources

KRCD: Job Title: Phone:
David Merritt Deputy General Manager, Power Operations 559-237-5567 ext. 111
16. Communications

The Contractor needs to understand the nature of KRCD’s business and agree to hold confidential any and all data and communications pertaining to the specific details of the power plant. Documents and data shared should remain in a secured area.

Both phone and internet service will be made available on site for the contractors use during the project term.

17. Concerns

Safety is a value at KRCD. Construction projects entail unique circumstances, and must be carefully evaluated to ensure that there are no unmitigated safety issues during or after construction. KRCD safety procedures and/or training will be incorporated and made available.

The Contractor should allow up to, one (1) hour for each employee to be safety indoctrination if they have not already been safety trained for this site. Each Contractor employee and/or sub-contractor employee will be required to verify that they have received KRCD safety indoctrination in the last 12 months, prior to engaging in any construction work on this project.
ATTACHMENT – A

Provide the required spares to perform a complete rewind of the existing units.

The quantities for the needed generator spares are as follows:

- Design and manufacture one set of stator windings and winding materials in accordance OEM specification, see enclosed specifications and drawings.
  - 238 stator coils, which includes spare and testing coils.
  - 1 set of two stainless steel surge rings insulated with Class F insulation.
  - 1 set of pole group jumpers with Class F insulation.
  - 14, 10-ohm/100-ohm, dual element (copper/platinum) calibrated resistance temperature detectors (RTD’s)
- Design and manufacture universal spare field poles. The electrical and mechanical characteristics shall be in accordance with OEM specification.
  - 5 universal configured field poles.
  - 7 sets of tapered keys. Two keys per set, one stationary and one driving key.

SUBMITTALS

The Contractor shall submit the following items for the proposed winding:

A) Working Drawings:

1) Coil template drawing and coil fabrication drawing showing twist in coil loops, radial angles of slots, diamond legs, loop drop dimensions and support ring locations.

2) Coil lap drawing showing the dimensions of the coil, slot sections, top and bottom end turns and coil leads.

3) Dimensioned cross sectional drawing of coil showing stranded, turn, ground insulation, slot (including dimensions and locations of wedge groove), wedge and fillers.

4) Transposition drawing showing method of insulating crossover points, development of strand crossovers, start and finish numbering system of strand ends, connecting strands coil to coil, and insulation of connections.

5) Drawing detailing procedures used to obtain a full Class F high temperature, high density, void free, insulation and corona suppression systems.
B) Data:

Furnish the following information excluding the procedures deemed to be proprietary.

1) Description of the insulation and corona suppression systems including a list of insulation and corona suppression materials.

2) Manufacturing procedures with full details, and if Mylar backed mica tape is required to fabricate coils with flexible knuckles, delineating how this tape shall be applied and interconnected with other backing mica tape.

3) Data for materials used for painting, side packing, vertical fillers and ripple spring including name of manufacturers and suppliers, manufacturers' material specifications, manufacturers' instructions for storage and use, and quantity of each of the materials required for installing each set of coils.

4) Shipping List of Materials furnished.

5) Material Safety Data Sheets (MSDS).

C) Test Procedures:

1) Test procedures for each of the factory tests delineating in details.

2) Applicable ANSI or IEEE Standards and Codes by sections.

3) Applied voltage: including magnitude, frequency, and duration of application.

2. STANDARDS AND CODES

A) Materials, workmanship, and tests shall conform to the applicable requirements of ANSI, ASTM, NEMA, and IEEE.

B) Electrical symbols shall conform to ANSI Y32.2.
3. **GENERATOR CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Pine Flat Synchronous Generators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Rating in KVA</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Amps</td>
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<tr>
<td>Percent Power Factor</td>
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<td>Phase</td>
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<tr>
<td>Cycles</td>
</tr>
<tr>
<td>Speed (RPM)</td>
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<tr>
<td>Temperature Rise in degrees C</td>
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<tr>
<td>Stator Winding Resistance, Ohms per phase at 75 degrees C</td>
</tr>
<tr>
<td>No. of Slots</td>
</tr>
<tr>
<td>Coil Pitch</td>
</tr>
<tr>
<td>Winding Connection</td>
</tr>
</tbody>
</table>

4. **TESTING AND QUALITY CONTROL:**

The District will not require the contractor to manufacture prototype coils to be subjected to destructive electrical tests and mechanical checks. However, the contractor will be required to manufacture one full set of coils, sixteen spares, plus six extra coils for production quality testing, totaling 238 coils per set. The District’s inspector will select the six coils from the 238 coils after their manufacture in the factory. One of the six coils will be dissected to examine the quality of the strand registry, number and size of voids, tape folds, and alignment of the copper in the slot section of the coil. The remaining five will be subjected to thermal cycling voltage endurance tests including standard quality diagnostic tests and mechanical checks. Powertech Labs will conduct the thermal cycling, voltage endurance and quality assurance tests. Powertech’s address is as follows:

Powertech Labs, Incorporated  
12388 – 88th Avenue  
Surrey, B.C.  
Canada V3W 7R7

The Contractor may witness the tests at the Powertech Labs.

Any paint utilized by the Contractor in the conductive and grading systems shall be tested in accordance with ASTM Test Number D3359-93, Standard Test Method for Measuring Adhesion by Tape. This test shall be performed on one of the five production coils.
Kings River Conservation District  
Turbine & Generator Upgrade / Repair  
SCOPE OF WORK

selected for dissection; the resulting Classification, as specified in the ASTM standard, shall not be below Classification 5B.

A) Coil Dissection:

1) One of the six coils after the production of all coils will be selected by the Engineer and will be dissected at six locations. Dissections will be done in the middle of the two slot legs and at the four knuckle ends where the conductive and grading system (paints and/or tapes) are overlapped. This single dissected coil will serve as an indicator of the coil design and shall represent the other manufactured coils.

2) The ground wall insulation shall ideally be uniform around the strand copper. If any voids are present, the following measurements will be taken:

   (a) The number and size of voids within the ground wall insulation system will be measured and documented.

   (b) The number and size of voids within the turn insulation system and oriented in direction of electric field between the conductor strands and the ground wall insulation system will be measured and counted.

   (c) The number and size of any voids created by tape folds bending significantly backward upon themselves will be measured and counted.

3) If any dissection samples from the coil are found to contain voids greater than 0.010 inches (0.25 mm) in size, then the set of coils will be considered as having failed the manufacturing process and rejected.

4) The degree of strand misalignment will be checked from each sample by measuring the distance from the outer layer of each strand to the outer layer of the ground wall insulation system, excluding the semi-conductive paint/tape system. The average thickness of insulation will be determined by using an optical measuring device, taking six measurements each from six dissected samples. On each sample, these points of measurement will be made at four locations (two on each side of the strand copper on the wide face and one on each side of the strand copper on the narrow face). The mean average thickness will be calculated as 1/36th of the sum of the thirty-six overall measurements.

   (a) Any areas where the calculated mean average thickness deviates by more than (-0 percent, +10 percent) of the design thickness (as shown in the coil cross section drawing furnished by the Contractor), will be documented and brought to the attention of the District Engineer.
(b) Any values from thirty-six thickness measurements that is less than 80 percent of the design thickness on the insulation system will be considered as having failed the manufacturing process and the set of coils will be rejected.

B) Lights-Out Test:

1) A lights-out test will be performed by the testing facility prior to conducting the voltage endurance tests.

2) If any one of the coils shows visible corona at below 16 kV rms, 60 Hz, the set of coils will be returned to the Contractor for correction. If the Contractor fails to correct the problem for the second time, the District may terminate the task order.

C) Thermal Cycling Test:

1) Perform thermal cycling test on the remaining five coils as described in IEEE standard 1310-1996 (R2004), with one coil designated as the control coil for temperature measurements.

2) Thermal cycling test shall be conducted between 40 – 155 °C every 90 minutes for 250 cycles.

3) After thermal cycling test as concluded the control coil shall be removed and no longer used in any remaining tests.

D) Voltage Endurance Test:

1) Perform voltage endurance testing on the remaining four coils in accordance with IEEE Standard 1553-2002 and IEEE Standard 1043-1996 (R2003) at 30 kV, 60 Hz, at 100 °C for a minimum of 400 hours. Repair of paint or tape during the test will not be allowed.

2) If there is no breakdown of insulation leading to insulation puncture after 400 hours of VET the test will constitute acceptance of the coils. If one coil fails between the 200th and 400th hours of the test, then two additional coils shall be provided to be tested. All these remaining specimens must pass the test to constitute acceptance of the coils. Failure of one or more coils during the first 200 hours of the test or failure of two coils between 200th and 400th hours will constitute failure of the coil design and rejection of the entire set of coils manufactured. The District may perform additional tests to determine the cause of failure on any failed coil(s).

3) The accepted set of coils (subjected to voltage endurance testing) will become the property of the District.
4) The defective coils, unclaimed by the Contractor within 30 days from the date of notice of failure, will be disposed of by the testing agency.

E) **Coil Manufacturing:**

1) The dimensions of the coils and other materials furnished shall adhere to the design dimensions deemed satisfactory for installation in the machine.

2) The stator coils shall have Class F insulation and shall be form wound and individually interchangeable. The total cross sectional area of the copper conductors shall not be less than the cross sectional area of the existing conductors. Each coil shall be contain a turn transposition by twisting a turn in the end turn section at the opposite connection end of the coil to reduce circulating current losses.

3) The coils shall be made up of rectangular strands of drawn, annealed copper wire, free from splices, splinters, flaws, rough spots, or sharp corners. Each strand shall be insulated with Class F Double Dacron Glass insulation. Each turn shall be insulated with a minimum of two edge lapped layers of mica tape continuously applied under constant tension.

4) The Start/Finish leads shall be a minimum of 18 inches long from the end of the knuckle area. The insulation on the copper strands shall be skinned 15 inches from the tip of the leads down to the knuckle area.

5) The coil ground wall insulation shall consist of multiple half-lapped layers of mica tape applied continuously throughout the length of the coil. The net thickness of the mica ground wall insulation on the end turn sections shall be at least equal to that applied to the slot section of the coil.

6) Sharp edges or points, abrupt change in shape or dimension such as folded insulation tapes will not be allowed in the insulation systems. Coils with sharp corners, on the slot section, with a radius less than 0.0625 inches (1.59 mm) will be rejected.

7) Asbestos materials will not be allowed in the manufacturing of stator coils.

8) The coils shall be constructed with a flexible knuckle design for easier installation in the machine. The use of Mylar backed mica tapes for the ground wall insulation shall be limited to the top and bottom knuckle areas between the scarf joints, which shall be outside the gradient paint or tape area. Each scarf joint shall have a minimum transition length of three inches spreading evenly and gradually between the different tapes. There shall be no Mylar tape in the slot sections between the scarf joints. A protective covering of woven glass binder tape shall be applied over the ground wall insulation tape.
9) Each coil shall be separately numbered before it is taken from the looping machine. Coil numbers shall be stamped into the exposed strand metal of the start lead of coils. Rejected coils shall be marked as directed. Replacement coils shall be assigned new numbers.

10) The slot section of the coil including a distance of 2 inches outside each end of the core shall be treated with a low resistance, semi-conducting, corona reducing paint or tape. Any deviation from the distance of 2 inches shall be as approved.

11) The portion of the end winding surface, extending several inches from the low resistance point towards the "U" bends and overlapping at least one inch with the low resistance paint or tape, shall be painted or taped with a voltage graded high resistance semi-conducting paint or tape, to limit coil surface voltage gradients to eliminate any surface discharge (corona onset) at voltage levels up to 16 kV rms, 60 Hz. The voltage gradient paint or tape shall not extend closer than 1/2 inch to any core end ground surface. If paint is used, the overlap area shall receive at least two alternate coats of low resistance and higher resistance paints. The rest of the coil shall be left unpainted. The length of overlap and the length of gradient material shall be noted on the working drawings.

5. **PACKAGING**

   A) Stator coils shall be packaged separately in wooden crates so that the gross weight of each crate does not exceed 1,500 pounds.

   B) Packaging shall be suitable for long-term indoor storage in an area that does not have temperature or humidity control except for materials with limited shelf life, which shall be packaged separately with labels showing the expiration dates of items. The materials with limited shelf life shall be freshly manufactured materials at the delivery time. In no case will the shelf life remaining on the date of delivery be less than 80 percent.

   C) Each crate shall be clearly marked with the following information:

      1) Contract number.

      2) Coil plant name, number, and location.

      3) Name of the parts and quantity. For stator coils include the coil sequence number clearly marked on coil for easier identification at site.

      4) Total gross weight and location of the center of gravity of the crate.
D) Three copies of the packing list for each crate shall be provided as follows:

1) One copy transmitted by letter to the Engineer.

2) One copy shipped inside the crate.

3) One copy in a protective jacket attached to the crate.

E) The material to be furnished under this order includes:

1) Designing, fabricating, factory testing, and delivering 238 stator coils which include a set of 216 coils to rewind one 70284 KVA synchronous generator, 16 spare coils, and 6 coils for quality assurance testing including thermal cycling and voltage endurance testing.

2) A set of fourteen 10-ohm/100-ohm, dual element (copper/platinum) resistance temperature detectors (RTDs) which includes two spares.

3) RTD cable for connecting the RTDs to the existing terminal blocks.

4) One set of 2 insulated nonmagnetic stainless steel surge rings. Including installation hardware.

6. FACTORY TESTING

The Contractor shall document and record factory tests performed during production of the coils.

The Contractor shall notify the Engineer with written notice 20 days in advance of final factory testing.

Each coil shall be given the following tests at the end of the production of each set of stator windings:

A) Dimensional Testing:

1) Each finished stator coil shall be measured, and dimensions recorded prior to performing any testing.

2) Coils shall have uniform and parallel spacing between coil end turns and shall be identical within ±0.125 inch of the nominal dimensions at the end, within range of +0.015 to 0.005 inch at the coil width in the core section and within range of +0.015 to 0.010 inch at the coil depth in the core section. The crossover point of the coils in the end turn shall have at least 0.25-inch separation. Each coil side shall be parallel with the slot core as required by the manufacturer's approved
procedure. Under-sizing the coil pitch to enhance coil insertion into the slot will not be allowed. Coils shall be free of any mechanical tension in the final position in the slot.

3) The leg drop clearance between coils, and the bottom leg clearance to the tie down rings, shall be in accordance with the manufacturer's approved inspection procedure.

4) Coils, which fail the checks for dimensional tolerance errors of any kind, will be rejected. Repair of rejected coils will not be allowed.

B) **Strand Insulation Test:**

1) Strand insulation test for each strand of each stator coil shall be tested at a minimum voltage of 120 volts 60 Hz, to demonstrate that it has maintained its electrical insulation from every other strand throughout the manufacturing process.

2) Finished coils failing the strand insulation test will be rejected.

C) **Turn-to-Turn Insulation Test:**

1) Turn-to-turn insulation test shall be conducted on multi-turn coils using electrical impulses with rise time between 0.1 and 0.2 microseconds, and a turn-to-turn test voltage with a peak value of the voltage impulse of 39 kV at 60 Hz (3.5 p.u.) for 5 to 10 pulses.

2) The test shall be in accordance with the latest IEEE Standard 522.

3) The coils will be rejected if there is indication of "shorts" on the pickup coil oscilloscope.

D) **Power Factor and Tip-up Test:**

1) Power factor tip-up test as specified in IEEE Standard 286 shall be conducted at 2 kV and 8 kV, 60 Hz.

2) The power factor tip-up value shall be obtained by subtracting the value of the power factor measured at 2 kV from that measured at 8 kV.

3) Each acceptable coil shall be permanently marked with its own power factor tip-up reading.

4) Finished coils with power factor tip-up values greater than 0.5 percent (0.005) or with power factor value greater than 1 percent (0.01) at 8 kV will be rejected.
E) **Ground Dielectric Test:**

1) Ground dielectric test shall be conducted as specified in IEEE Standard 4.

2) The core sections of the coils shall be wrapped with aluminum foil or enclosed in sheet metal "L's" or troughs under compression, in such a manner that exposes the coil surfaces to the high voltage across the ground wall.

3) Test voltages of 36 kV, 60 Hz shall be used for coils manufactured by Vacuum Pressure Impregnation, or 61 kV direct current shall be used for coils manufactured by Resin Rich B-stage tape. Test voltage shall be sustained for one minute without failure.

F) **Rejection Criteria of Coils for Above Five Tests:**

If more than 5 percent of the total coils fail to meet any one of the above tests including dimensional checks, with the exception of the Power Factor Tip-up Test, the District will reject the set of coils.

G) **Surface Resistivity Test:**

1) Surface resistivity test shall be conducted on both sides of the four graded portions of each coil to determine the surface resistivity values of the gradient paint or the tape after the coils have been tested in the dummy stator core.

2) Coils with any resistivity value outside the predetermined acceptable range shall be corrected.

H) **Coil Surface Corona Test:**

1) A batch sample quantity of 10 percent of each set of coils shall be tested at 16 kV rms, 60 Hz using a corona scope with all the strands tied together and the surface of the slot portion grounded.

2) If evidence of visible corona is found on any coil, another sample of 10 percent or minimum of 20 coils shall be tested.

3) If additional two or more coils are found with evidence of visible corona, the entire set of coils shall be tested.

4) The Contractor shall investigate and correct the surface resistivity and the grading system problems for coils if evidence of visible corona is observed on any coil tested. Corrective procedures and materials shall be approved prior to beginning corrective work. If the Contractor fails to correct the problems after two trials, the District may reject the set of coils.
7. **REWIND MATERIAL**

**A) RESISTANCE TEMPERATURE DETECTORS**

1) RTD shall be Minco Products Co., Model S10893; or equal. Each dual element RTD shall have 4 leads. The copper element shall measure 10-ohm at 25 degree C and the platinum element shall measure 100-ohm at 0 degree C. The temperature coefficient of resistance shall be 0.00427 ohm/°C for the copper element and 0.00385 ohm/°C for the platinum element over the range 0 to 100 degrees C, 80 degree C, 100 degree C and 120 degree C and the test results shall be furnished to the Engineer after testing and prior to shipment. Calculation of the coefficient of resistance shall be made for the resistance change between 25 degree C and 100 degree C.

2) The RTD shall be factory assembled in the form of core length filler strip with the heat-sensing element located in the middle section of the filler strip between the core ends. The RTD filler strip shall be made of semi-conductive impregnated material. The complete assembled RTD shall have the same size and thickness as of the semi conductive center separators used for the specific winding.

3) The RTD cables shall be furnished with 18 AWG and the wires insulation shall be colored red for the 10-ohm, green for the 100-ohm, and one black and one white for the common leads.

4) Each complete RTD shall be tested for insulation resistance by applying 1,000 volts between the four detector leads, tied together, and the RTD filler strip surface.

5) Resistance and continuity tests shall be performed on each detector lead from each RTD after Item 4, is performed.

6) New RTD cable, 18 AWG / 4 wires shall be furnished to replace the existing armored cables between the RTDs and the existing terminal boxes. The total length of the RTD cable shall be in a roll of 500 feet. The cable shall be from Copper Industries Inc., Belden Wire & Cable, No. 83654; Alpha Wire Corp., No 5524; or equal.

**B) Surge Rings**

1) A set of 2 nonmagnetic stainless steel insulated surge rings, one for each end shall be furnished, including supports, insulation blocks, and mounting hardware. These rings shall be insulated with at least nine layers of ½ lapped mica tape with catalyzed resin applied by brush in between layers. Insulation shall be type Class F.
2) The surge ring segments shall be tested in accordance with IEEE Standard 4. Test voltage of 29 kV, 60 Hz; or 49 kV dc shall be sustained for 1 minute without failure.

8. ACCEPTANCE TESTS

The District will conduct acceptance tests within 60 days upon receiving the complete shipment of the stator windings. The Contractor may have a representative present to witness the acceptance tests.

The District will notify the Contractor not less than 15 days in advance of commencing testing.

Each coil will be subjected to the following tests for acceptance purposes

A) Coil Resistance Test:

1) Coil resistance test will be conducted on each coil with a Kelvin Bridge or a Digital Low Resistance Ohmmeter, DLRO. Measurement will be made at the two leads approximately 12 inches extending beyond the top end of the knuckle.

2) The average resistance value measured, after correcting to 75°C, will be used to calculate the incremental stator winding resistance losses.

(a) It is agreed by the parties that if the stator resistance is higher than the specified value, damage will be difficult and impractical to determine the actual amount of such damage; therefore, liquidated damages will be determined and assessed as specified herein.

(b) Final payment for the total price of the task will be decreased by $M for each watt of loss caused by the stator winding resistance exceeding the value specified.

3) The value of incremental stator resistance, in ohms, shall be determined from the following formula:

\[ R = (N * R_m) - R_g \]

Where

\( R \) is the incremental stator resistance per phase per circuit, in ohms,

\( R_m = (R^2/2R) \) is the average coil resistance value as measured during acceptance testing, corrected to 75°C, in ohms,
R<sub>g</sub> is the guaranteed value of winding resistance per phase at 75°C, in ohms.

N is the number of coils per leg per phase.

4) The total value of decrease (D), in dollars, is determined from the following formula:

\[ D = M \times 3 \times (I)^2 \times R \]

Where:

M is defined as the loss of each watt caused by the stator winding resistance exceeding the value specified (R<sub>g</sub>), in dollars,

I is the rated value of line current, in amperes, and

R is the incremental stator resistance per phase per circuit, in ohms, as evaluated in section 3) above.

The values of N, R<sub>g</sub>, M, and I are as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>72</td>
</tr>
<tr>
<td>R&lt;sub&gt;g&lt;/sub&gt;</td>
<td>0.0024</td>
</tr>
<tr>
<td>M</td>
<td>8.705</td>
</tr>
<tr>
<td>I</td>
<td>2,556</td>
</tr>
</tbody>
</table>

B) Ground Dielectric Test:

1) Ground dielectric test will be conducted on each coil by applying 33 kV rms, 60 Hz, or 56 kV dc between the coil leads, tied together, and the ground wire clipped to the core section of the coil.

2) The voltage will be raised smoothly to test value held for 1 minute and then immediately lowered smoothly to zero.

3) Coils failing test will be rejected.

C) Turn-to-turn Test:

1) Turn-to-turn insulation test shall be conducted on multi-turn coils using electrical impulses with rise time between 0.1 and 0.2 microseconds, and a turn-to-turn test voltage with a peak value of the voltage impulse of 39 kV at 60 Hz (3.5 p.u.) for 5 to 10 pulses.
2) The test will be in accordance with IEEE Standard 522.

3) Any coil with indication of "shorts" on the pickup coil oscilloscope will be rejected.

D) **Strand Insulation Test:**

1) Strand insulation test for each strand will be tested at 120 volts, 60 Hz.

2) Coils failing test will be rejected.

3) Coils rejected shall be replaced with new coils, which will be subjected to tests and conditions specified in this section.
ATTACHMENT – B

Provide a cost estimate to perform the field labor portion of the complete unit disassembly, inspection, cleaning, stator rewind, rotor pole refurbishment and unit reassembly project along with all required field testing.

1. Submit a timeline for this project identifying all relevant milestones for the duration of the project.

General details of work scope needed for the above tasks – actual tasks need to be performed per the OEM instructions (not in order of task to be performed):

- Perform all required field measurements / verifications / match marking prior to disassembly
- Remove all required support equipment to allow access to generator
- Generator cooler removal / pressure checks / repairs as needed / reinstall
- Draining of oil from tubs
- Collector ring removal
- Thrust block removal
- Generator / turbine coupling removal
- Bearing removal and inspections
- Collar / bracket removal
- Needed dowel work
- Generator rotor removal
- Complete rotor / spider inspection for wear / stress cracks
- Pole removal from rotor
- Proper packaging of rotor poles for shipment to refurbishment facility (contain asbestos)
- Asbestos abatement process / stator coil removal / certification for OK to work following atmospheric test conditions warrant.
- Cleaning / inspection / testing of stator core
- Packing box inspections
- Wicket gate inspections
- Seal rings
- Stator coil install and connections
- Electrical testing of stator
- Reassembly of rotor with poles / electrical testing
- Reassembly of shafts, bearings, collars, brackets, etc..
- Oil tub refilling
- Oil filtering / flush until determined clean per OEM instructions
Kings River Conservation District
Turbine & Generator Upgrade / Repair
SCOPE OF WORK

- Measurements, shaft run out and clearance verifications made
- Reassembly of all support equipment
- Balancing / alignments
- Performance testing

Description of the rotor pole refurbishment is as follows:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Hitachi: Units 1, 2, and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>KVA</td>
<td>61,100 and 70,284</td>
</tr>
<tr>
<td>Voltage</td>
<td>13,800</td>
</tr>
<tr>
<td>Amperes</td>
<td>2,556.3 @ 61,100 KVA</td>
</tr>
<tr>
<td>Percent Power Factor</td>
<td>90</td>
</tr>
<tr>
<td>Phases</td>
<td>3</td>
</tr>
<tr>
<td>Frequency in HZ</td>
<td>60</td>
</tr>
<tr>
<td>Speed in RPM</td>
<td>257</td>
</tr>
<tr>
<td>Number of Poles</td>
<td>28</td>
</tr>
<tr>
<td>Operating Temperature (°C)</td>
<td>60 and 80</td>
</tr>
<tr>
<td>Manufacturing Numbers</td>
<td>151891-1, 151901-1, 151909-1</td>
</tr>
</tbody>
</table>

The following describes the scope of this work:

1. Roundtrip transportation of field poles from Pine Flat Power Plant to the service facility. Dimensions and approximate weight of each crate is 70” X 30” X 26” and 3000 pounds. Pine Flat Power Plant is located on the following address:

   27709 Pine Flat Rd.
   Piedra, CA 93649

2. The overall weight of these field poles should be uniform within ±5 pounds of the original design weight to minimize balancing requirements on site. Weights of the field poles shall be recorded before and after the service and shall be documented in the final report.

3. Remove the field winding from pole, strip the existing insulation, clean, and de-bur each turn of the copper conductor. Conduct detail inspection of the copper conductor and document any abnormalities. Notify the department representative of any necessary work on the field winding.
4. Inspect the core assembly for looseness and alignment of the lamination stack, make adjustments as necessary.

5. Thoroughly inspect the core end-plates for cracks and deformation due to heat or mechanical stress.

6. Thoroughly inspect the amortisseur winding components for cracks and deformation, document the findings and include on final report.

7. All brazed areas on the amortisseur assembly shall be liquid penetrant inspected in accordance with ASTM E165 recommended procedures. Any cracks or lack of fusion between the amortisseur components will need to be corrected.

8. Remove the field coil leads and install new leads following original manufacturing and material specifications. Bend leads to match existing (original) configuration. If field leads are made of multiple laminations, tip of leads (¼ inch) shall be brazed to facilitate brazing of the leads at site during installation. Document the position of the original leads and adjustments the position of the new leads as necessary for a consistent elevation of the leads on the field poles. Any modification shall be documented and reported to the department representative.

9. Re-insulate the field coil with Class F or higher-class material. The new insulation shall not contain asbestos.

10. Apply new ground wall insulation to the core assembly. Epoxy-potting method is not allowed for installation of the ground wall insulation.

11. Replace upper and lower collars with new collars manufactured from NEMA Grade G-11 material.

12. Determine the force exerted on the field coil at 1.5 times the synchronous speed. The coil press machine shall simulate this force when the coils are being pressed and cured.

13. Assemble field pole coil; install turn insulation and hot press using the calculated force to cure the insulation.

14. Perform a high potential test in accordance with IEEE Standard C50-10. The applied voltage during the high potential test shall be 2500 VAC or 4250 VDC.

15. Perform turn-to-turn surge test to check for insulation integrity. The amplitude of the impulse used during the surge test shall be 100 volts for each turn in the field pole coil.
16. Fabricate a full set tapered keys (tapered wedges). Each set requires two keys, one stationary and one driving key.

17. The refurbished field poles shall be individually packaged in a moisture resistance bag or wrap suitable for long-term indoor storage in an area that does not have temperature or humidity control. The field poles shall be individually crated on wooden crates and properly secured to prevent damages during transportation and storage.

18. Pole body and coil dimensions, lamination dimensions and quantity, type and thickness of material used in ground wall, turn-to-turn, top and bottom collar, end turn insulation systems, and photographs depicting the progress of work shall be documented in the final project report.
ATTACHMENT – C

Provide a cost estimate to perform a rotor removal only, rotor pole refurbishment, winding inspection and reassembly.

1. Submit a timeline for this project identifying all relevant milestones for the duration of the project.

General details of work scope needed for the above tasks – actual tasks need to be performed per the OEM instructions (not in order of task to be performed):

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ATTACHMENT – D

Provide a cost estimate to perform weld repair of installed high head runners.

In regards to the runners, there are visual signs of cavitation damage on the runners – the District requests the following:

General details of work scope needed for this task:
- Remove runner from lower cone / draft tube per OEM instructions
- Perform detailed inspection to determine actual repairs needed / true cost developed
- Transport as needed to repair facility
- Heat treat runner (pre/post) / weld repair per required material specification / procedures
- Balance as needed
- Transport back to District facility
- Install runner per OEM instructions

The District does not have a predetermined weld procedure for the runner at this time – it does have the original inspection reports showing the material as 13%Cr – 5%Ni Stainless Steel Casting.

Detailed inspections were performed in 2006 by a third party contractor and the cavitation has been monitored by facility personnel on an annual basis going forward. The cavitation damage has been considered minor in the areas that it has been observed.

KRCD is exploring two options to determine the composition / weld procedure:
- Requested weld procedure from original OEM (Hitachi)
- Perform nondestructive analysis during fall 2012 maintenance period

The complete survey performed in 2006, will be made available to the selected vendor – the following table is data based on inspections performed on the Unit 3 runner and should be used as a guide to determine potential work scope.
### Table 1

Summary of inspection measurements. Blade thickness (measured on Blade 7) approximately 1½" upstream from the trailing edge is 1.00" about 2" from the band and 0.85" about 9" from the band.

<table>
<thead>
<tr>
<th>Blade</th>
<th>Suction Face Depth</th>
<th>Suction Face Extent/Location</th>
<th>Band</th>
<th>Crown</th>
<th>Pressure Side at Trailing Edge</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.06</td>
<td>0.05</td>
<td>2.25</td>
<td>14</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>0.12</td>
<td>0.05</td>
<td>2.5</td>
<td>21</td>
<td>7</td>
<td>10.5</td>
</tr>
<tr>
<td>3</td>
<td>0.09</td>
<td>0.07</td>
<td>2</td>
<td>24</td>
<td>3.5</td>
<td>13.5</td>
</tr>
<tr>
<td>4</td>
<td>0.10</td>
<td>0.09</td>
<td>2</td>
<td>21</td>
<td>5</td>
<td>8.5</td>
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<tr>
<td>5</td>
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<td>7</td>
</tr>
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<td>6</td>
<td>R</td>
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<td>16</td>
<td>5.5</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>0.04</td>
<td>R</td>
<td>2</td>
<td>19</td>
<td>(to R)</td>
<td>6 (to R)</td>
</tr>
<tr>
<td>8</td>
<td></td>
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<tr>
<td>9</td>
<td>0.12</td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td>0.08</td>
<td>0.10</td>
<td>2</td>
<td>18</td>
<td>6</td>
<td>8</td>
</tr>
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<td>14</td>
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<tr>
<td>15</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **F**: frosting
- **R**: roughened F but not to measurable depth
- **E**: elongated wastage from erosion and cavitation
- **DS**: downstream

**Note:**
- Blade thickness upstream from the trailing edge is 1.00" about 2" from the band and 0.85" about 9" from the band.

**Table 1** Summary of inspection measurements.