JEFF L. TAYLOR PINE FLAT POWER PLANT

KINGS RIVER CONSERVATION DISTRICT

FRESNO, CALIFORNIA

BID SPECIFICATIONS FOR
DESIGN, FURNISH AND INSTALLATION OF
UNITS-1, 2 AND 3 CONDITION MONITORING SYSTEM

SPECIFICATION # 203.02.100

Contents

1. INTRODUCTION

Kings River Conservation District, KRCD (referred to as “Owner” or “District” from hereafter) owns and operates the Jeff L. Taylor – Pine Flat Hydroelectric Project. The Jeff L. Taylor – Pine Flat Hydroelectric Project is located on the north bank of the Kings River approximately 200 feet downstream of the United States Army Corps of Engineers’ (USACE) Pine Flat Dam in Fresno County, California.

The Jeff L. Taylor – Pine Flat Hydroelectric Project has a nameplate generation capacity of 165 megawatts (MW) and generates electricity from water released by USACE through Pine Flat Dam during flood control operations and as requested by the Kings River Water Association[1] for irrigation demand. The Jeff L. Taylor – Pine Flat Hydroelectric Project consists of power generation facilities with three identical 55-MW Vertical Francis turbine-generator units. Currently, powerhouse generates energy from Pine Flat Dam flow releases between 500 – 8,000 cubic feet per second (cfs). Water used for hydroelectric energy generation is returned to the Kings River approximately 200 feet downstream of Pine Flat Dam.

The owner plans to purchase and install Condition Monitoring Equipment for all three generating units and invites relevant bidders to submit their proposal.

2. SCOPE

This specification establishes the performance, design and verification requirements for the Condition Monitoring System to be installed at the Pine Flat power plant on units 1, 2, and 3.

The following shall be provided as the minimum base scope for each generating unit-

2.1. One (1) Magnetic Flux probe
2.2. Four (4) Air Gap sensors on the generator stator top
2.3. Four (4) Air Gap sensors on the generator stator bottom (if deemed necessary)
2.4. Two (2) Generator Guide Bearing Radial Shaft probes for Upper Guide Bearing
2.5. Two (2) Generator Guide Bearing Radial Shaft probes for Lower Guide Bearing
2.6. Two (2) Turbine Guide Bearing Radial Shaft probes for Turbine Guide Bearing
2.7. One (1) Stator Core Absolute Vibration Accelerometer
2.8. One (1) Stator Frame Absolute Vibration Accelerometer
2.9. One (1) Turbine Head Cover Absolute Vibration Accelerometer
2.10. Signal Conditioners required for all the above signals, mounted in a NEMA-4X rated enclosure
2.11. One (1) Sync Probe
2.12. Processing Unit and processing modules for all the above signals– each generating unit shall have its dedicated cabinet mounted in one (1) NEMA-12 enclosure with proper cutouts, swing doors, heating, cooling and air circulation units as required, communication modules and other appurtenances as required.

2.13. One (1) Desktop Computer to serve as the Serve and Data Acquisition Unit
2.14. Appropriate software including licenses for continuous unit condition monitoring and data acquisition
2.15. All required cables and cable hardware including communication cable (EtherNet, Fibre, etc.)
2.16. Site Commissioning and supervision support
2.17. Training (collective- one time)- at the commissioning of first unit.

2.18. Optional Items: Any additional measurement techniques that may benefit the owner and that can be tied to the same condition monitoring system. Provide itemized cost and detailed description of the optional materials.

The owner may opt to install all three units at once or spread out to three years during the annual maintenance season, with one unit installation per year. This will depend on the lead time proposed by the supplier. If the lead time does not support installation of all three units in a given year, the condition monitoring system for each unit shall be stored at the manufacturer's facility until ready for installation onsite. Each condition monitoring system unit cabinets and components shall be factory tested prior to shipping of that particular unit.

3. BID DUE DATE

All bid proposals are due at 2:00pm (Pacific Time) on Monday, May 5, 2025.
There will be no extension to the due date.

Bids must be submitted via online platform www.bidnetdirect.com (Bid # 203.02.100). Emailed or Paper copies are not acceptable. A courtesy email shall be sent to owner's project manager at pniroula@krcd.org once the bid is successfully submitted on the platform.

4. BID WALK

Bid walk can be facilitated for April 15th and 16th, 2025 between the hours of 9:00am to 12:00pm, 1:00pm to 3:30pm PST on both the days. If the bidder wishes for a site visit, the bidder shall notify the Owner's project manager via email by April 1st, 2025 with a request for the above time slot. The request will be approved on a first come first serve basis and if all four slots are occupied, there will be no additional bid walk dates offered.

One unit generator will be made available after proper lock-out tag-out for the bidder's site visit. One stator top cover will be removed for inspection of the air gap.

Owner Project Manager- Pawan Niroula, email: pniroula@krcd.org
Email Subject line: Pine Flat Condition Monitoring Bid walk

Site Address: 27709 Pine Flat Rd, Piedra, CA 93649

The bid walk is not mandatory.

5. REQUEST FOR INFORMATION

Any request for information (RFI) shall be emailed to the Owner's project manager with clear indication on the email subject line. The details of the request for information shall be included in the body of email.

Owner Project Manager- Pawan Niroula, email: pniroula@krcd.org
Email Subject line: Pine Flat Condition Monitoring- RFI

The owner will make arrangements to address the requests at the earliest but shall have the right to decline response or to provide any information or documentation requested via such RFI.

Last date to submit an RFI for this bid is set for Monday, April 21, 2025 by 3:00pm (Pacific Time)

6. APPLICABLE STANDARDS

The equipment provided under this specification shall conform to all applicable standards of ANSI, NEMA, NEC, and IEEE, and shall be in accordance with all applicable requirements of local, state, and federal codes and regulations.

7. BIDS EVALUATION CRITERIA-

1. Total Cost – 40%
2. Past Performance and reference projects – 20%
3. Project Execution Methodology – 20%
4. Knowledge base of hydroelectric turbine-generator units, data interpretation capabilities - 20%

8. BID PROPOSAL REQUIREMENTS

Bidders shall provide concise writeup for each of the following sections in their proposal.

1. Cost- shall be itemized for all the materials, training, commissioning and site supervision services, Data Interpretation services. The itemization shall break down the cost total based on each of the three units and any common cost item to all three units shall be itemized separately.

2. Past Performance- bidders shall have experience of design and installation of similar condition monitoring system in at least fifteen (15) hydroelectric units of similar size within last 7 years. Include list of project references and details of contact person from the owner's side.

3. Project Execution Methodology- A high level description of how the bidder will execute the project if selected for the contract. Supplier shall also explain in this section their proposed system description, personnel capabilities, after sales services, service contacts, availability of spares parts.

4. Data Interpretation service - A high level description of bidder's capabilities with trained and qualified personnel and methods used to interpret the condition monitoring data and how the interpretation could help the owner make critical asset management decisions. This will also apply to supplier's depth of knowledge and understanding of vertical Francis turbine-generator hydroelectric units.

The monitoring system supplier shall provide interpretation of initial test readings and two subsequent test readings taken during the first year following installation. The supplier must have over 10 years of experience in the interpretation of on-line monitoring software readings on vertical shaft hydro-electric machines. Based on the on-line monitoring software results, the reports must provide an assessment of the rotor and stator condition, overall generator behavior, overall shaft vibration and other significant parameters monitored as well as unit behavior in transient mode based on the dynamic values obtained with the monitoring equipment.

8.1. Bid Submittal Requirements-

Bids shall be complete and concise and shall include the following information-

1. A detail of scope of work, materials, labor, optional items proposed.

2. Itemized cost details, itemized for materials, labor cost, spare parts, site supervision, commissioning, training- required per Unit Generator/ Turbine.

3. Supplier shall also provide itemized cost line item the data interpretation and provide an annual machine assessment report, following commissioning of each unit.

4. At least 5 references of past project of similar sizes and scope of work in the United States in past 5 years. Bidder shall include short and specific details of the work performed at these projects and contact details of the customer's Project Manager and/or technical lead.
5. Project Schedule: A high-level project schedule outlining details of the design, procurement, fabrication/ manufacturing, testing, delivery, installation, site testing, commissioning and training stages.

6. Applicable high-level drawings for general sensor installation layout pertaining to vertical Francis Turbine-Generator hydroelectric units. Additionally, a basic network diagram of components shall be submitted outlining the applicable communication protocols or standards planned for the project. So that the owner has a better understanding of the space requirements, bidders shall also submit basic layout drawings of the cabinets and intermediate junction boxes and/or pull boxes along with dimensions of each. The bidder may furnish these drawings from a past project of similar size and scope for the bidding purposes.

7. Exceptions and Clarifications- Submit any exceptions and/or clarifications as a separate section in the proposal. Bidder shall indicate the sections of this specifications for exceptions. The contract documents will include the exceptions and clarifications for the successful bidder.

8. Bidder shall submit their expected progress payment schedule along with the bid, subject to approval by the owner before signing the contract with the successful bidder. However, as per owner's standard practice, a 10% retention will be held on each of the progress payment. The 50% retention will be released to the successful bidder (contractor) after successful commissioning of the first unit, 20% retention will be released after the successful commissioning of the second unit and the remaining 30% retention will be released after successful commissioning of the third unit.

9. SYSTEM REQUIREMENTS

9.1. Performance

9.1.1 The Air Gap Sensor

This sensor shall be a non-contact type sensor which generates the necessary electric field to measure the distance between its surface and a target; in this case, the rotor-stator gap in the generator. The gap between the stator and the rotor is to be measured to determine the optimal probe range. The sensor shall continually operate and maintain its accuracy in the temperature and magnetic fields experienced in this environment.

Sensors shall be provided to dynamically monitor the generator rotor/stator air gap under all operating conditions from generator standstill up to machine over speed condition. Capacitive type sensors shall be supplied since they provide reliable operation and are immune to strong magnetic fields, carbon dust and dirt, deposits of oil and, high shock vibration and EMI-RFI. The air gap sensors shall be stator-mounted only. Sensors shall only be glued to the stator core and not the wedges, as the wedges vibrate and may cause the sensor to be dislodged. Measurements shall be strictly on the theory and principles of capacitance with regard to current, voltage, distance and plate area, with one plate of the capacitor being the capacitive sensor and the other plate being the rotor pole face. Sensors of field loss/current loss principle with 2, 3 or more plate construction are not acceptable. Rotor-mounted sensors are not acceptable since they may be dislodged during machine operation and jeopardize the machine safety.

The sensor shall be easy to install without removing the rotor or poles and there shall be no adapter between the sensor and the signal conditioner. **Bidder's commissioning personnel/ installation supervisor must install the air gap sensors on the generator stator and route the cable to the first junction box.**

Bidders shall make a note of the exception if the proposed air gap sensor installation requires removal of the generator rotor.

To ensure accurate air gap monitoring, a minimum of four (4) air gap sensors on a single plane shall be installed on the stator top. Requirement for another set on the stator bottom shall be evaluated by the bidder during the bidding stage.

Bidders shall include cost for all material required for air gap probes installation, example- adhesive/ glue, suitable cable clamps for the cable run along the stator and generator frame.

Generator Nameplate Data:

Continuous rating of 61.10MVA, 0.9 PF, 60 deg C temperature rise, 13.8kV, 257.14 rpm, 60Hz frequency with a 360kW, 375V Excitation System. The overload capacity of the generator is 70.28MVA (115% of the rated MVA) at a temperature rise of 80 deg C.

For reference, the stator diameter is 17 feet (5200mm) and height is 7 feet (2150mm). The nominal air gap between the generator stator and rotor is 24mm.

Sensor

- Operating temperature range: 0° to 125 °C *[32 to 257°F]*
- Magnetic Field Immunity: up to 2 Tesla (50 or 60 Hz)
- Dust and Oil Contamination: Films have no effect
- Humidity up to 95%, non-condensing
- Sensor material: Glass reinforced laminates
- Triaxial cable with grounding wire assembly
- Triaxial cable material: PVDF over FEP jacket / Teflon® insulation
- Non-contact proximity, capacitive technology
- Absolute maximum temperature: 155 deg. C (311 deg. F)
- Resistance to industrial chemicals and solvents: Very good

Extension Cables

- Cable Type: Triaxial
- Minimum Bending Radius: 10cm (4 inches)
- Temperature Range: 0 to 75°C *[32 to 167°F]*
- Type S Cable Material: PVC jacket / PE insulation
- Absolute minimum length: Nominal minus 0.5m (19.7”)

Signal Conditioner

- Power requirements: 24 Vdc ± 15%
- Consumption: 120 mA max
- Warm-Up: Time 30 Minutes
- Temperature Range:
  - Operating: 0 to 55°C *[32 to 131°F]*
  - Storage (Measuring Chain): -25 to 70°C *[-13 to 158°F]*
- Status Indicator: Bicolor LED

Measuring Chains (2 to 42mm range / 79 to 1654 mils)

- Linearized output signal from LIN-type signal conditioner: 4 to 20 mA
- Bandwidth: DC to 1.2 kHz (-3 dB)
- Accuracy: ≤3% of reading in gap detection zone
- Repeatability (% of reading): ±0.3%
- Temperature drift (at mid-range): ± 2%
- Load at Output: 500 Ω max
- Sensitivity: 0.4 mA/mm (10.2 µA/mil)

Bidders shall make note of any deviation and/or exceptions of the above parameters along with bid submittal.

9.1.2 Relative Shaft Vibration Sensors

Non-contact capacitive type proximity probes shall be provided in order to dynamically monitor the motion of the generator/turbine shaft relative to the bearings. Capacitive proximity probes with built-in signal conditioner shall be provided due to their insensitivity to false indications as a result of electrical runout, shaft currents, and minor surface irregularities. Two (2) proximity probes shall be provided to monitor radial shaft vibration at each guide bearing. The sensors shall be installed at 0 deg and 90deg orientation at the Generator Upper Guide Bearing, Generator Lower Guide Bearing and Turbine Guide Bearing The proximity probes must meet the following minimum requirements:

• Measuring ranges:	0.3 to 2.3 mm *[11.8 to 90.6 mils]*	0.5 to 4.5 mm *[19.7 to 177 mils]*
• Output: 4 to 20 mA		
• Sensitivity:	8 mA/mm *[0.2 mA/mil]*	4 mA/mm *[0.1 mA/mil]*
• Accuracy:	± 1.25 % FSR (calculated on a full scale range)	± 2.5 % FSR (calculated on a full scale range)

- Repeatability: ± 0.5 % FSR (calculated on a full scale range)
- Residual noise: ± 50 µm (at mid-range)
- Bandwidth: DC to 1000 Hz (-3dB)
- Load at current output: 500 Ω max
- Temperature drift: < 350 ppm/°C (at mid-range)
- Short circuit protection: Built-in
- Temperature Range:
  - Operating: 0 to 65°C *[32 to 140°F]*
  - Storage: -25 to 70°C *[-13 to 158°F]*

Bidders shall make note of any deviation and/or exceptions of the above parameters along with bid submittal.

The sensors/ probes shall be mounted to a bracket installed outside the bearing housing for all the bearings discussed. **Bidders shall make a note of the exception if the proposed sensors/ probes cannot be mounted without removing the bearing housing tub or the cover.**

The bidder shall design and provide the suitable brackets for mounting the sensors/ probes.

The following table provides the OEM bearing clearance to the main shaft-

Bearing	Bearing to Shaft Clearance (Radial)- one side
Generator Upper Guide Bearing	0.0071 +/- 0.0008 inch
Generator Lower Guide Bearing	0.0059 +/- 0.0008 inch
Turbine Guide Bearing	0.0061 inch – 0.0089 inch

9.1.3. Absolute Bearing, Stator Core, and Turbine Cover Vibration Sensors

Low-frequency type accelerometers shall be provided to monitor the absolute vibration of the stator core, stator frame, head cover, and draft tube. One (1) accelerometer shall be installed on a non-conductive plate installed on the stator core. One (1) accelerometer shall be installed on the turbine head cover to monitor vertical (z-axis) vibration and one (1) accelerometer shall be installed on the draft tube.

The accelerometers shall meet the following minimum requirements:

- Sensitivity 500mV/g
- Measuring range: 10 g peak
- Amplitude non-linearity: 1%
- Bandwidth:
  - 0.4 to 1600 Hz (+/- 10%)
  - 0.2 to 3700 Hz (+/- 3 dB)
- Reverse polarity protection: Built-in
- Temperature range: -55° to 90°C *[-67 °F to 194 °F]*
- Power source: Constant current source supply (ICP® transmission mode)

Bidders shall make note of any deviation and/or exceptions of the above parameters along with bid submittal.

9.1.4. Magnetic Flux Sensor

The magnetic flux between the generator rotor and stator shall be continuously monitored and correlated with the air gap and rotor pole temperature parameters. One (1) magnetic flux sensor shall be provided per generator and shall be installed upon the stator core next to an air gap sensor. The sensor must meet the following minimum requirements:

Sensor

- Output: Magnetic flux to voltage
- Interchangeability: <1% F.S.R.
- Short circuit protection: Built-in
- Temperature range: 0° to 125 °C *[32 to 257°F]*

Extension Cables

- Cable Type: Shielded twin axial

Signal Conditioner

- Flux density output range: Up to ±2 tesla

- Operating frequency: 2 to 60 Hz (no attenuation)
- Outputs:
  - Raw flux density: ±5 V
  - Maximum flux density: 4 to 20 mA (per pole)
- Sensitivity:
  - Raw flux density: 2.5 V/tesla
  - Maximum flux density: 8 mA/tesla
- Accuracy: ± 1% F.S.R.
- Linearity: ± 0.5% F.S.R.
- Repeatability: ± 0.05% F.S.R.
- Minimum detection threshold: 0.03 Tesla
- Temperature drift: < 500 ppm/°C
- Power requirements: 24 Vdc ± 10%

Bidders shall make note of any deviation and/or exceptions of the above parameters along with bid submittal.

9.1.5. Phase Reference

A synchronization probe shall be supplied to provide a reference pulse used for rotor pole identification purposes. It shall be installed near the shaft in the turbine pit and detect the passage of a target mounted on the shaft.

9.2. Monitoring Hardware

Each generating machine shall be equipped with an integrated acquisition unit designed to perform signal processing, alarm monitoring and data acquisition for protection, trending, analysis and diagnostic purposes. The monitoring unit shall be rack-mountable, on-line programmable, multi-tasking and digital processing. Multiple racks shall be interconnected according to the number of inputs to monitor. Information shall be visible through a front-panel display in graphic forms and settings shall be adjustable locally via a front-panel keypad. The rack shall have a universal AC & DC power supply.

9.3. Rack Mount Cabinet/s

A 19” Rackmount instrumentation cabinet shall be supplied to monitor each unit. A NEMA-12 cabinet shall be supplied. The cabinet frame, rear door, and gland plates shall be steel, 2 mm *[78.7 mils]*, Side panels Steel, 1.5 mm *[59.1 mils]*. The cabinet shall have sufficient fans with filter for intake and exhaust, and internal cabinet ID labelling for all sensory inputs. The color: frame, rear door, roof, and side panels RAL 7035 light gray; plinth base RAL 9005 black. The front door shall be aluminium with single-pane safety glass 3 mm. Both front and rear doors shall be either LH or RH hinged to allow for multiple location options. Side panels shall be removable. Anchoring shall be plinth based to the concrete floor. I/O cables can enter from either top or bottom gland plates. Grounding bar shall be fixed to bottom of frame. Power input shall

be AC /DC with auxiliary AC supply panel with surge suppressor and EMI filter. Ambient temperature shall be 0 to 40 degrees C. Component operating range shall be 0 to 50 degrees C. Cabinet shall have an option of adding BNC panels connected to each sensory measuring chain and the synchronization probe for external testing. Multifunctional Panel shall consist of an Ethernet Switch with 6 copper ports and 2 fiber optic ports for SC connectors, and also six (6) annunciation relays: 4x alarm and 2x status. Cabinet shall include power bar 125Vac, 15a, type B, with a minimum of 4 outlets. Cabinet shall have a Factory Acceptance Test conducted with third part certified testing equipment according to ISO-9001 standards.

9.4. Communication

The monitoring unit of each generator shall communicate with a central system controller through a dedicated network using Ethernet TCP/IP up to 100Mbps or Fiber Optic network. The monitoring unit shall be configured from the system controller via the Ethernet network or by downloading a configuration file from a USB key.

9.5. Alarms

The monitoring unit shall perform alarm detection and relay trigger, feature multiple configurable alarm thresholds per input and be capable of performing conditional alarm on individual channels, It shall perform self-checks and provide System OK and Channel OK relays.

9.6. Measurements & Processing

The monitoring unit shall perform various types of synchronized measurements (sampling, one-turn, multi-turns, alarm, trending). Acquisition of all parameters shall be referenced to the minimum air gap value of each rotor pole.

The monitoring hardware per generator must:

- Accept inputs from air gap, vibration (proximity, displacement, acceleration, velocity), and other sensors
- Analog inputs: 4-20mA
- Perform synchronized measurements of all connected parameters under all operating and transient conditions from standstill to runaway speed
- Permit continuous alarm monitoring with user-defined dual-level thresholds per input; capable of performing conditional alarms and measurements; trigger dry contact relays
- Accept control input signals such as synchronization, acquisition trigger, externally triggered inhibit, and external trigger signal.
- Sampling rate of 8,000 samples/sec per channel
- Ethernet TCP/IP communication up to 100 Mbps and communication to SCADA/DCS/PLC
- User-configurable display: real-time bar graph or numerical, unit of measurement, scale, alarm thresholds
- Outputs available:

- Real-time raw analog signal,
- Processed signals (rms, peak, peak-peak, min. / max. / average values),
- Protection relays

9.7. Dynamic Tolerances

The following table expresses values used in dynamic measurement of air gap, shaft run out and stator core vibration. When the generator is operating, the respective heat expansion of the rotor and stator shall remain concentric and uniform to prevent harmful deformation of the stator frame and rotor spider. During the warranty period, the unit shall operate within the Acceptable Range based on capacitive measuring chains and related Air Gap and Vibration Polar Plots per the table below with Maximum Air Gap Deviation not to exceed 20%. This is based on the machine in normal operating condition at full load and temperature stabilized after a minimum of 4 hours in operation.

MECHANICAL TOLERANCES				
		Deviation*		
Parameter	**Definitions**	**Erection**	**Acceptable**	**Critical**
Max. Air gap Variation	Maximum difference between rotor and stator measured at any point on a single plane.	**< 13%**	**13 to 30 %**	**> 30%**
Stator apparent circularity	Difference between maximum inside radius and minimum inside radius, measured from the rotor rotation axis.	**< 7%**	**7 to 20%**	**> 20%**
Stator concentricity	Difference between rotor rotation axis and the best stator centre measured on the same plan, calculated from the rotor reference pole.	**< 5%**	**5 to 10 %**	**> 10%**

Rotor circularity	Difference between maximum outside radius and minimum outside radius, along the same horizontal plane.	**< 6%**	**6 to 10 %**	**> 10%**
Rotor concentricity	Difference between the rotor rotation axis and the best rotor centre calculated from the outside radius of each pole on the same plane.	**< 1.2%**	**1.2 to 4 %**	**> 4%**
VIBRATION**				
Shaft	Hydraulic units (0-300 rpm)***	**< 4**	**4 to 12**	**> 12**
	Hydraulic units (300-1200 rpm)	**< 2**	**2 to 6**	**> 6**
Stator core	Measured between the core and the frame	**< 1**	**1 to 2**	**> 2**
Stator frame	Measured between the frame and the sole plate	**< 1**	**1 to 5**	**> 5**

Notes :

* – Deviation expressed in percentage of theoretical (nominal) air gap.

**– Relative vibrations expressed in mils peak-to-peak.

***_ Pine Flat Generators rated speed = 257 rpm

Any deviations from the above table should be noted on bidder's list of Clarifications/ Exceptions.

9.8. System Controller: System and Software

The on-line system controller shall be dedicated to system control and configuration, data storage and data analysis for diagnostic; no other software shall be installed and used on this computer besides those required by the system and authorized by the system vendor. The system controller shall have remote monitoring capability via the corporate WAN network if necessary.

9.8.1. Software

The Software shall be used for on-line condition monitoring of rotating machinery. It shall be of modular design to accept parameter specific module. The software shall allow field hardware configuration and control, on-screen display of monitored values, parameter trends, alarm status and annunciation, perform and display data analysis, and manage the database.

The system shall be capable of the following:

- Intuitive graphic user interface
- Comprehensive graphs (rectangular, trend, polar, orbit, spectrum), machine mimics and lists
- Collecting, storing, displaying, and correlating data of all monitored parameters and process variables to support comprehensive machine diagnosis
- Alarming on static and dynamic data with at least two levels of alarm, and include a stored events manager to provide tracking of pre and post alarm data measurements and system events
- Ability to alarm on changes to the rotor shape
- Ability to set broadband alarms and define up to five specific spectral bands, with two levels of alarm on each specific spectral band
- Correlating all parameters to the smallest electrical and mechanical unit of the machine (i.e. the passage of a rotor pole) for quick and easy machine diagnostics
- Monitoring parameters and displaying measurements covering all modes of generator operation from machine standstill up to runaway speed
- Background automatic acquisition of data for trending at user-defined intervals
- Password protection to prevent unauthorized access
- On-screen warning of alarms per unit and per input
- Simultaneous monitoring of multiple machines
- Remote monitoring via the plant or corporate network
- Fast and easy export utility: downloadable data to MS Excel spreadsheet
- PLC/SCADA integration

The software must have all the necessary analysis tools to provide the following minimum outputs for machinery diagnostics:

- A supervisory display (machine mimic) with up to date values of monitoring points and alarm conditions
- Simultaneous display of multiple parameters for data/event correlation
- Trend plots of all status and dynamic values
- Fast Fourier Transform Spectrum plots of vibration and other parameter for analysis

- Orbit graphs of the rotor shaft path inside each guide bearing referenced to the actual rotor position
- Animated polar view illustrating the rotor rotation behavior inside the stator, with automatic calculation of the rotor-stator roundness and eccentricity as well as color-coded indication of actual air gap results versus tolerances guideline
- Toggle capability from top air gap view to bottom air gap view (if the bottom air gap is deemed necessary)
- Graphs of the minimum air gap for each rotor pole over one or multiple revolution
- Alarm graphs reflecting a minimum of 500 rotations configurable for a specific number of pre and post turns of the machine after an alarm has been detected or triggered by a user-defined event
- Plot grouping functions for easy access to related data.

The software must be capable of displaying air gap results on a tolerance table.

9.8.2. Server

The Server shall be a reputed brand with suitable Windows version for the operating system with a high volume data storage capacity, flat screen monitor (27" minimum). The computer and software shall have automatically launch upon every computer startup; automatically reboot in case of computer malfunction. The system controller shall be located in the existing plant control room.

Bidder should include the cost of the server and associated hardware, including monitor.

9.8.3. Alarms

The system shall continuously, and independently, monitor all inputs for alarm conditions with four configurable alarm thresholds per input. The relay modules associated to the respective alarms shall be energized on alarm detection. Specific alarm and tripping set points will be defined at a later date. For future expansion, provisions shall be made for enough relay contacts to interface with unit tripping circuit fed with 125VDC circuit. **However, the owner currently does not want the condition monitoring system to initiate unit tripping.**

9.8.4. Communication to the existing monitoring PLC and OSI-PI monitoring platform

The existing unit monitoring is OSI-PI system that receives input signals from a Phoenix Contact PLC (Phoenix Contact part 2700973) for reservoir, downstream river, unit generation, temperature and flow parameters. However, there are currently no PLC based controls. The proposed condition monitoring system shall be capable of interfacing various unit status parameters available from the existing unit system, such as but not limited to; MW, MVAR, current, voltage, headwater and tail water levels, bearing oil, stator, and bearing temperatures. The new condition monitoring system shall be capable of sending the air gap and vibration data to the existing PLC and OSI-PI system.

9.8.5. Communication to the future SCADA system

The owner plans to install Allen Bradley PLC platform-based SCADA controls system for all three units in the near future. The platform will most likely be based on Control Logix 5000 series platform.

The condition monitoring system under this scope of work shall be compliant to this future platform in terms of its ability to communicate with the PLC for data acquisition on various plant and unit parameters. The communication interface will need to be coordinated by supplier and owner. The supplier shall include all necessary hardware, interfaces and software along with the proposal.

However, the owner expects the condition monitoring system to have its own data acquisition system with a physical server and its own dedicated monitoring system installed as a part of the package. The monitoring system/ software shall be able to integrate all three units into a single workstation that shall be installed in the existing plant control room.

The system should be capable of displaying alarms from all three units on the same screen and to the extent possible a single screen graphics shall display the vital high-level data for all three units at once. The screens for monitoring and controls must be approved by the Owner before the final implementation.

10. RECOMMENDED SPARE PARTS

Supplier shall provide a list of recommended spare parts showing manufacturer's name, part number and recommended quantity. Spare parts cost must be itemized in the cost proposal.

11. INSTALLATION AND COMMISSIONING

Supplier shall provide commissioning of the system (including site commissioning tests and travel costs) as a separate option. The commissioning expert shall also serve as the installation supervisor for owner's installation crew at site. The commissioning expert shall have at least five years of experience in commissioning, testing and training customers of such system. The expert shall provide services for site testing and commissioning, including troubleshooting and modifications to software and/or hardware connections as needed.

The owner plans to use its internal staff for site installation of the cabinets, cables and raceways. However, the supplier site representative shall install all the sensors- air gap, vibration probes and accelerometers.

The supplier shall provide subject matter expert to commission the system and take dynamic readings of all operating conditions such as slow roll, 25%, 50%, 75% speed, SNL, Field Flash,

Synchronize to Grid, 25% load, 50% load, 75% load, Full Load Cold, Full Load Hot, and Load Rejection if applicable. Warranty coverage for the performance of the machine monitoring system in terms of its function as an entire "system" shall be based upon the supplier being mandated for all of the above-mentioned activities.

12. TRAINING

Training shall be provided by supplier as a separate option in the price breakdown. The training shall cover both basic engineering aspects of the condition monitoring system high level design, sensors working principle as well as training for operations and maintenance of the components and the interpretation of software graphics, alarms and trending. The owner prefers the training to held during or shortly after the commissioning so that the site team benefits from hands on training.

If additional trainings are offered at the supplier's or manufacturer's location, that can be attended by the owner at that specific date and location, bidders shall include the Training Program schedule and course details.

13. WARRANTY

The supplier shall provide a full Twelve (12) month warranty for the entire system including the software. The warranty period shall start once each unit is successfully commissioned and the owner's representative signs off on all the required commissioning and test reports.

The owner plans to install condition monitoring system during the plant annual maintenance period, typically between October through next February. Therefore, the installation and commissioning may span over a three-year period or occur in a single year depending on the lead time proposed by the supplier in their bid. The 12-month warranty shall be applicable to each unit after the completion of successful commissioning of that specific unit.

Supplier shall specify how they would secure the warranty- either through a bond or some other method.

14. POST CONTRACT AWARD SUBMITTALS-

The successful bidder (or the selected contractor/ supplier), after contract execution, shall provide the following documentation during different stages of project execution-

14.1. Project Schedule

A detailed project schedule shall be submitted that outlines all activities for the project outlining details of the design, procurement, fabrication/ manufacturing, testing, delivery, installation, site testing, commissioning and training stages. Schedule shall be in the latest MS Project format and both the pdf and original format shall be submitted. Subsequent revisions shall be submitted during the course of the project for any major changes affecting any stage of the project lifecycle. The first version of such project schedule shall be submitted within 10 working days from the date of Notice to Proceed.

14.2. Drawings

Supplier shall electronically submit the drawings and information specified herein to Owner in accordance with the agreed-upon schedule. Supplier's drawing file format shall be compatible and able to be manipulated with latest version of Autodesk AutoCAD. All other information shall be in PDF format.

Outline and general arrangement drawings showing overall dimensions, location of equipment, conduit entry, sensor location, etc. Elementary diagrams of equipment including ratings, as well as communication diagrams. The general arrangement drawings should show the location of all sensor installation, installation technique, wiring route, location of all intermediate junction boxes, pull boxes, cabinet installation location and workstation location.

A detailed wiring diagram showing point to point connection shall be provided to facilitate onsite installation work for the Owner.

AutoCAD copies of all final drawings shall be submitted for the final As-built submittals.

The first set of such documentation shall be provided within 60 calendar days of Notice to Proceed.

14.3. Data Sheets

Data sheets of all the components used in the provided system shall be submitted for approval prior to construction. All datasheets can be combined in one single pdf submittal.

The first set of such documentation shall be provided within 60 calendar days of Notice to Proceed.

14.4. Bill of Material (BOM)

A bill of material shall be provided for all the components used in the system, including name of manufacturer and corresponding part number used. Generic and incomplete part number(s) is not acceptable. BOM can be part of Drawing submittal.

The first set of such documentation shall be provided within 60 calendar days of Notice to Proceed.

14.5. Test Procedures

Test procedures shall be submitted for owner's review at least 60 days prior to Factory Acceptance Testing (FAT). The Testing shall be based on the procedure and all associated forms. The test report shall be submitted to the owner within 15 working days after the actual test.

The equipment shipment is subject to FAT report approval by the owner. All the punch list items noted during FAT shall be remedied before the shipment.

A separate commissioning procedure shall be submitted for owner's review at least 60 days prior to commissioning date.

14.6. Operation & Maintenance (O&M) Manual

A project specific O&M Manual must be provided after the successful commissioning of the first unit. The manual shall include clear instructions on sensor installation, alarm and warning settings, setting of software screens, interpretation of measured data, general troubleshooting techniques, recommendation of periodic maintenance of the system, final Bill of Materials, As-built copies of all the previously submitted drawings, final datasheets. The O&M manual shall be bundled together into a single pdf document- no printed copies are required. A generic O&M manual is not acceptable.

Drawings, instruction manuals, datasheets and other documents shall be project specific; generic documents and drawings are not acceptable. The owner will provide standard AutoCAD title blocks, document coversheets and predefined document numbers and filename for each of the formal submittal.

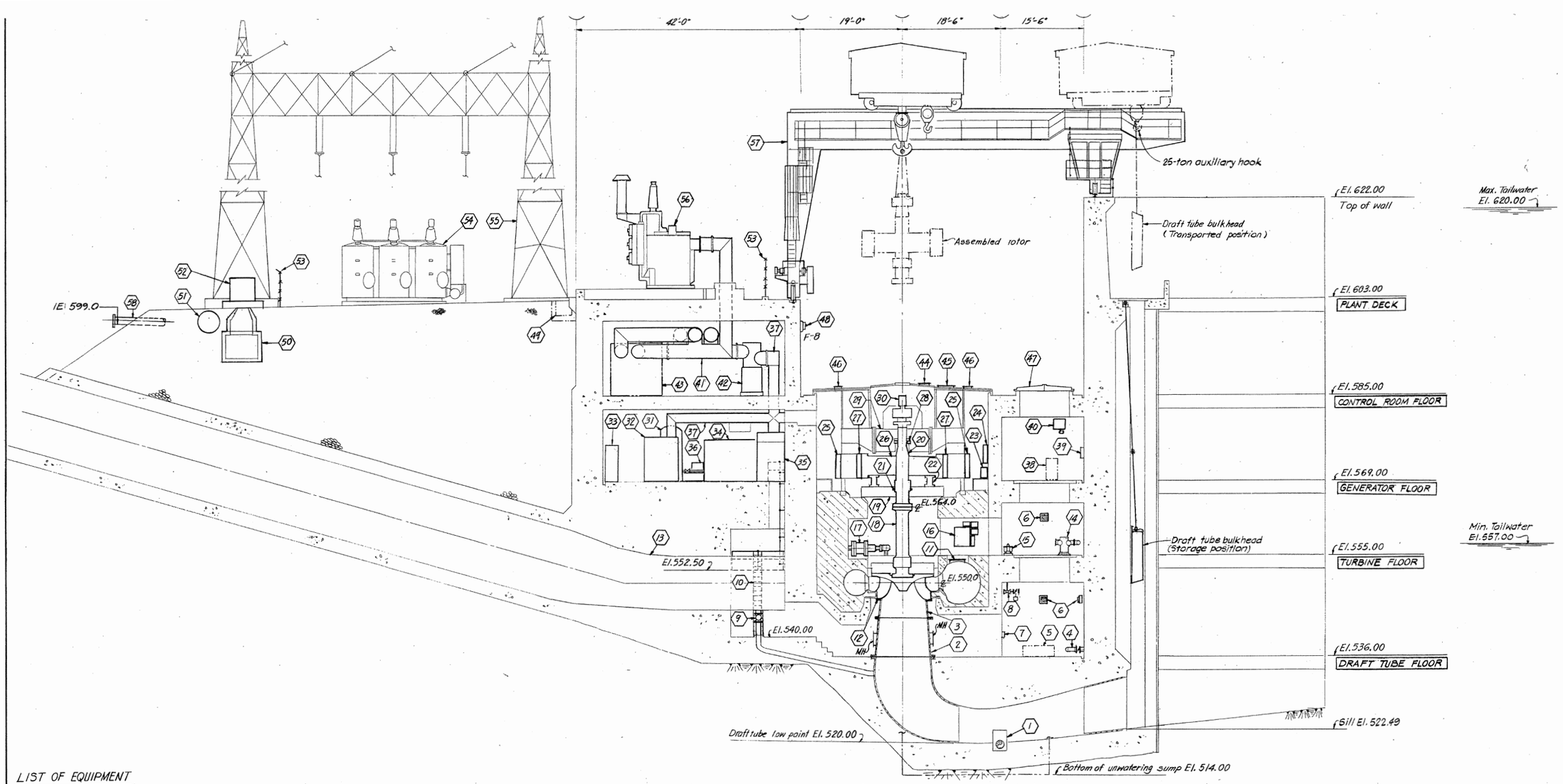
Since all three units are identical, a common submittal for the project is acceptable but clear notes shall be provided for unit specific details.

Complete O&M Manual shall be submitted to the owner within 15 working days from the successful commissioning date.

The final progress payment will be withheld until all the above documents are submitted and accepted by the owner and the plant personnel are trained on operating the new system.

15. APPENDIX

15.1. Drawing- Powerhouse and Unit Transverse Section



LIST OF EQUIPMENT

1. Draft Tube Unwatering Inlet Grating of Draft Tube Unwatering Niche
2. Draft Tube Lower Removable Cone
3. Draft Tube Upper Removable Cone
4. 10" Draft Tube Fill Line
5. Alternative Location NO. 2 - For future air compressor (turbine damping system) if req'd
6. Unit Heater
7. Local Control Station for Emergency Closure of 8" Cooling Water Supply Emergency Shutoff Valve
8. 8" Cooling Water Supply Guard Valve with Operator
9. 10" Ball Valve for Penstock Unwatering
10. Ladder (for Emergency Exit)
11. Spiral Case Access Manhole
12. Turbine Runner
13. Penstock
14. 8" Duplex Strainer
15. 1½" Duplex Strainer
16. Turbine Terminal Box and Instrument Panels
17. Turbine Servomotor
18. Turbine Main Shaft
19. Generator Lower Bracket
20. Generator Shaft
21. Generator Lower Guide Bearing
22. Brake and Jack
23. High Pressure Oil Equipment
24. Generator Terminal Board
25. Generator Air Cooler
26. Rotor
27. Generator Pole
28. Generator Thrust Bearing and Upper Guide Bearing
29. Generator Upper Bracket
30. Speed Signal Generator
31. Governor Oil Pressure Tank
32. Excitation Transformer
33. Cubicle for Generator Circuit Breaker Air Compressor
34. Governor Actuator
35. Potential Transformer and Surge Arrestor Cubicle
36. Governor Air Compressor
37. AC Non-Segregated Phase Bus Duct
38. CO_2 Cylinder Bank
39. Generator CO_2 System Control Panel
40. CO_2 Exhaust Fan
41. AC Isolated Phase Bus Duct
42. Generator Circuit Breaker
43. Current Limiting Reactor
44. Access to Generator Interior
45. Rotor Pole Access Cover
46. Air Cooler Removal Cover
47. Double Leaf Roof Scuttle
48. Wall Exhaust Fan F-B
49. Electrical Pull Box #5
50. Septic and Holding Tanks
51. Diesel Fuel Tank
52. Diesel Generator
53. Fence
54. 230KV Oil Circuit Breaker
55. 230KV Transmission Line Take-off Structure
56. Main Transformer
57. 150-Ton Gantry Crane
58. 10" Switchyard Drain Inlet

AS BUILT

Scale 0 8 16 24 Feet

RELEASED FOR CONSTRUCTION

NO	DATE	DESCRIPTION	BY	CH.	APPD.
1	6-15-84	As built per FJE records	HJ	JT	RSP

REVISIONS

KINGS RIVER CONSERVATION DISTRICT

KINGS RIVER HYDROELECTRIC PROJECT
UNIT I - PINE FLAT POWER PLANT
POWERHOUSE

EQUIPMENT LOCATION TRANSVERSE SECTION

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
A MORRISON-KNUDSEN COMPANY
180 HOWARD STREET, SAN FRANCISCO, CALIFORNIA 94105

DESIGNED ____ INSPECTED ____ DATE
DRAWN ____ RECOMMENDED ____
CHECKED ____ APPROVED ____ DRAWING NO. LG-11-505SIR1

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