PROJECT MANUAL

FOR

POWER PLANT COOLING TOWER REPLACEMENT
P-01 COOLING TOWER PROCUREMENT

Request for Proposal
Revision 0
October 2, 2019

PROPOSALS DUE: 3:00 p.m., Central Time, October 23, 2019

University of Northern Iowa
Cedar Falls, Iowa

PRVN Consultants, Inc.
710 Pacha Parkway, Suite 1
North Liberty, Iowa 52317
(319) 359-7808
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Division 00

Procurement and Contracting Requirements

University of Northern Iowa
UNI-CP000279
Power Plant Cooling Tower Replacement
P-01 Cooling Tower Procurement
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SECTION 00 01 07
SEALS AND SIGNATURES

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

James J. Nonnenmann

Pages or sheets covered by this seal: Section 23 65 00

Signature:  

Date:  10/2/2019  
License Expires:  12/31/2020  

****

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

Kevin C. Voss

Pages or sheets covered by this seal: Section 23 65 00

Signature:  

Date:  10/2/2019  
License Expires:  12/31/2020  

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**ENCLOSED REFERENCE DRAWINGS**

| GA10 General Arrangement – Grade Level                      | ENCLOSED |
| GA20 General Arrangement – Sections                         | ENCLOSED  |
Division 01

General Requirements

University of Northern Iowa
UNI-CP000279
Power Plant Cooling Tower Replacement
P-01 Cooling Tower Procurement
SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Definitions.
   2. Project description.
   4. Work by others.
   5. Sequence and progress of work.

1.2 PROPOSAL SUBMISSION

A. Seller shall submit one (1) electronic copy in portable document format (pdf) of proposal
documents to University of Northern Iowa Attention Jon Westhoff no later than 3:00 P.M.,
October 23, 2019. All Sellers interested in receiving and responding to bid opportunities for the
University of Northern Iowa must register with purchasing.

B. Electronic proposals shall be submitted in portable document format (PDF) generated directly from
the native file. Scanned hard copies shall not be allowed.

1.3 DEFINITIONS

A. The terms “Seller” and “Supplier” are used interchangeably throughout the RFP and refer to the
organization providing cooling tower equipment, components, and accessories and manufacturer’s
field services under P-01 Cooling Tower Procurement.

B. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or other
paragraphs or schedules in the Specifications and similar requirements in the Contract
Documents. Where terms such as “shown,” “noted,” “scheduled,” and “specified” are used, it is to
help locate the reference; no limitation is intended except as specifically noted.

C. The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading,
unpacking, assembly, installation, and similar operations.”

D. The term “install” is used to describe operations at the Project site, including the actual “unloading,
unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing,
curing, protecting, cleaning, and similar operations.”

E. The term “provide” means “to furnish and install, complete, and ready for the intended use.”

F. The term “substantial completion” means “the completion of the entire Work or designated portion
thereof, including submittals required under the Contract Documents, except minor items, which in
the opinion of the Design Professional and/or the Owner’s Representative will not interfere with the
complete and satisfactory use of the facilities and/or physical improvements for the purposes
intended.” Following “substantial completion,” Owner may occupy or utilize the Project, or a
designated portion, for the use in which it is intended without unscheduled disruption.

G. The term “final completion” means “the completion of the entire Work, including submittals
required under the Contract Documents following the substantial completion punch list inspections
conducted by Design Professional and/or Owner’s Representative.” “Final completion” occurs on
the date when the Seller’s obligations under the Contract are complete and accepted by the
Owner.
1.4 PROJECT DESCRIPTION
A. Project Location: Work shall be performed under this Contract on the campus of the University of Northern Iowa at the Power Plant, Cedar Falls, IA 50614.

The University of Northern Iowa includes a central power plant originally constructed in 1980 and operates one (1) 7.5 MW steam turbine and its auxiliary equipment and systems. This plant represents the primary source of heating for the buildings on campus, including athletic, academic, and administrative facilities. The Power Plant generates electricity to supplement purchased power for the campus. The existing cooling towers provide the heat rejection capacity necessary to serve the steam surface condenser associated with the steam turbine generator within the plant. This cooling tower has reached the end of its useful life and is in need of replacement.

B. The Seller shall furnish all information necessary for, and incidental to, this Project as indicated on documents dated October 2, 2019.

C. General Description of Work: To replace aging equipment and systems and improve reliability for the facilities served on campus, the Owner desires to replace the existing field-erected cooling tower. The Project will also upgrade associated auxiliary systems, including condenser water pumping, makeup water systems, electrical service, and the process control system.

1.5 CONTRACT DESCRIPTION (P-01 COOLING TOWER PROCUREMENT)
A. Work as described in the Specifications includes engineering, fabrication, testing, and delivery of three (3) factory-assembled, packaged, induced-draft, crossflow cooling tower cells for use in a power plant environment to the University of Northern Iowa Power Plant, Cedar Falls, IA, 50614.

B. The Seller shall furnish and include all labor, materials, equipment, transportation, coordination, and facilities necessary for the proper execution of the Power Plant Cooling Tower Replacement Project, Contract P-01 – Cooling Tower Procurement.

C. Cooling tower cells shall consist of structure (walls, casing, and fan deck), fan shroud, mechanical equipment (fan, drive, and driveshaft), electric motors, heat transfer media (fill), drift eliminators, hot water distribution system, cold water basin, access and safety appurtenances, auxiliary components and accessories, and services of Seller’s Field Technical Advisor.

1.6 WORK BY OTHERS
A. Contract P-02 Pump Procurement: Engineering, fabrication, testing, and delivery of three (3) vertical turbine wet pit type and single-stage or multistage (as required) vertically mounted condenser water pumps. Pump packages shall consist of pump casing, column assembly, discharge head assembly, suction bowl and impeller, motor, auxiliary components, suction fittings, and accessories and services of Seller’s Field Technical Advisor.

B. Contract P-03 Cooling Tower VFD Procurement: Engineering, fabrication, testing, and delivery of three (3) three-phase, adjustable variable-frequency drives (VFD) with reduced-voltage solid-state (RVSS) bypass starters for operation with cooling tower fan motors and services of Seller’s Field Technical Advisor.

C. Contract C-01 General Construction: The Owner will separately contract for the balance of plant work of this Project. Specifically, work completed by Contract C-01 General Construction will include:
1. Receive, unload, store, and install two (2) factory-assembled and tested packaged crossflow cooling tower cells and auxiliaries (furnished by P-01).
2. Receive, unload, store, and install constant speed, vertical turbine condenser water pumps (furnished by P-02).
3. Receive, unload, store, and install adjustable VFDs (furnished by P-03).
4. Demolish three (3) existing field-erected crossflow cooling tower cells located at grade to the west of the Power Plant.
5. Demolish three (3) centrifugal vertically mounted condenser water pumps, including starters or variable-frequency drives.
6. Demolish and/or relocate existing piping, valves, specialties, accessories, electrical devices, cabling, and conduit to support new construction.
7. Modify existing equipment foundations and concrete pads as required for new equipment.
8. Modify existing cooling tower concrete basin as required to accommodate new equipment loads and arrangement, as well as pipe support loads.
9. Furnish and install new maintenance access platform and stairs between new cooling tower cells.
10. Furnish and install process piping systems, including condenser water supply and return (CWS/CWR), process cold water (PCW), and other systems as required for complete and operable cooling tower system.
11. Furnish and install electrical work, including starters, panelboards, light fixtures, power, instrumentation and control, and communications cabling, conduit, and raceway.
12. Procure and install instrumentation and field devices not specifically provided with P-01 Cooling Tower Procurement and P-02 Pump Procurement.

D. Process Control System Integration: Owner will separately procure the technical services of a Process Control System Integrator for providing the control system hardware, software, and programming services needed to integrate the new equipment into the existing Allen Bradley PLC-based process control system.

1.7 TIME

A. Submit a schedule with bid and an updated delivery schedule seven (7) calendar days after issuance of purchase order. Delivery schedule shall accommodate overall Project Schedule and shall be in sufficient detail to allow coordination with other contracts.

B. Schedule shall be broken down as follows:
1. Owner issues purchase order to Seller: November 11, 2019.
2. Shop Drawings: November 11, 2019 through December 6, 2019.

C. If Shop Drawing approval is delayed due to incomplete or non-compliant submittals from the Seller, Seller shall expedite production and delivery to maintain the Project schedule at no additional cost.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION
PART 1  GENERAL

1.1. SECTION INCLUDES

A. Submittal procedures.
B. Required submittals.

1.2. PROCEDURES

A. Samples, Shop Drawings, product data, and/or manufacturer’s data shall be submitted to, and approved by, the Design Professional prior to purchase or fabrication. No work shall commence until all related submittals have been approved by the Design Professional.

B. Failure of the Seller to submit submittals in a timely manner may result in the Owner withholding Seller payments.

C. The Seller shall include the following information on each submittal item:
   1. Project Title: University of Northern Iowa – Power Plant Cooling Tower Replacement
   2. Project Number: UNI-CP000279.
   3. Contract Title: P-01 Cooling Tower Procurement.
   4. Date.
   5. Seller’s name and address.
   6. Component manufacturer name and address.
   7. Specification Section and Article Number and/or Drawing Number.
   8. Deviations from Contract Documents and/or product or system limitations, which may be detrimental to successful performance of the completed work.
   9. Deviations from or revisions to previous submittals.

D. Submittals shall contain the Seller’s review stamp indicating that the following items have been verified:
   1. Contains only listed manufacturers.
   2. Equipment connections coordinated with affected trades.
   3. Dimensions and service clearances are suitable for the intended location.
   4. Dimensions and capacities coordinate with structural support, pads, etc.
   5. Coordination with adjacent work.

E. Provide space for Design Professional review and action designations.

F. Revise and resubmit submittals as required; identify all changes made since previous submittal.

G. Incomplete submittals: Design Professional and Owner will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Design Professional or Owner.

1.3. SHOP DRAWINGS AND PRODUCT DATA

A. In no instance shall the Contract Drawings be reproduced for submittals.

B. Submit multi-page .pdf of each submittal within the division folders labeled by CSI number, description. (Example -10 5116 Custom wood lockers.pdf.)

C. Individual submittal packages shall be prepared for items in each Specification section. Items within a single Specification section may be packaged together where possible. An individual submittal may contain items from multiple Specifications sections if the items are intimately linked (e.g., pumps and motors).
D. Clearly identify submittals with the same name or symbol used in the Contract Documents. Clearly identify model, size, finish, options, etc.

E. Electronic Submittals via Submittal Exchange:
   1. Owner will establish and administer the Submittal Exchange process.
   2. Training is available from Submittal Exchange regarding use of the website. The Design Professional will arrange the time and location for such training.
   3. Transmit each submittal with transmittal letter indicating date, Project title, Project number, Seller's name and address, and pertinent Specification section number. Send a copy of all transmittal letters to the Construction Manager’s attention at the time of each submission.
   4. Sequentially number the transmittal forms. Identify re-submittals with original number and an alphabetic suffix.
   5. Distribute copies of reviewed submittals to concerned parties. Instruct parties to report any inability to comply with provisions.
   6. Seller shall transmit all Shop Drawings and product data submittals to the Design Professional in electronic (PDF) format.
   7. All submittals shall be numbered according to Specification section with sub numbers for each submittal. Ex. 042000-1. If additional submittals are needed in the same section, number sequentially. Ex. 042000-2. Re-submittals shall maintain the same section number but include a revised “R” submittal number. Ex. 042000-1R1. If resubmitted a second time, 042000-1R2.
   8. The intent of the electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround times.
   9. Electronic submittals shall be submitted in portable document format (PDF) generated directly from the native file. Scanned hard copies of Shop Drawings shall not be allowed.
   10. Internet service and equipment requirements:
       a. Email address and Internet access at Seller’s main office.
       b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

1.4. SAMPLES

A. Submit to the Owner and Design Professional two (2) copies of all required samples for the Design Professional’s and the Owner’s sole use. The Seller shall submit additional copies required for the Project’s own use.

B. Submit samples to illustrate functional and aesthetic characteristics of the Product with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

C. Submit samples of finishes from the full range of manufacturers’ standard colors, textures, and patterns for the Design Professional’s selection.

D. Include identification on each sample with full Project information.

E. Seller shall maintain an approved set of samples on-site during construction.

1.5. SELLER’S AND COMPONENT MANUFACTURERS’ INSTRUCTIONS

A. Submit Seller’s and component manufacturer’s instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing in quantities specified for product data.

B. Identify conflicts between Seller’s instructions and Contract Documents.

1.6. CERTIFICATES

A. When specified in individual Specification Sections, submit Seller’s and component manufacturer’s certificates to the Design Professional for review.
B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or based upon previous test results on material or products, but must be acceptable to the Design Professional.

1.7. SELLER RESPONSIBILITY

A. Review for compliance with Contract Documents and approve submittals before submission.

B. Seller: Responsible for:
   1. Determination and verification of materials, including manufacturer's catalog numbers.
   2. Checking and coordinating information in submittal against requirements of Contract Documents.
   3. Determination of accuracy and completeness of dimensions and quantities.
   4. Confirmation and coordination of dimensions and field conditions at Site.
   5. Safety precautions.
   6. Coordination and performance of Work of all trades.

C. Obtain written permission from Design Professional, prior to bidding, for any variation in submittals from requirements of Contract Documents following substitution procedures. Variance request shall include differential costs to the Owner and schedule impact, if any.

D. When Shop Drawings are revised for resubmission, identify all changes made since previous submission.

E. Begin no fabrication or Work that requires submittals until return of submittals by Design Professional with Design Professional stamp as either "Reviewed (R)" or "Reviewed as Noted (RAN)." Any related Work performed prior to such return of pertinent submittals shall be the sole expense and responsibility of Seller.

F. Submittals containing language imposing duties on others (verification of dimensions, supply of related information, etc.) inconsistent with conditions and provisions of Contract shall be null and void.

G. Submittals shall not be used as media for inquiries regarding or verification of information needed by Seller from others. Inquiries for or verification of information shall be made by separate Seller submittal using Request for Information (RFI) process.

H. Make any corrections or changes in submittals required by Design Professional and resubmit until stamped as either "Reviewed" or "Review as Noted" by Design Professional. Indicate any changes that have been made other than those requested by Design Professional. Indicate revision number and date in document revision block or other clearly identified location on document.

1.8. DESIGN PROFESSIONAL RESPONSIBILITY

A. Do not make "mass submittals" to Design Professional. "Mass submittals" are defined as six (6) or more submittals or items in one day or fifteen (15) or more submittals or items in one week. If "mass submittals" are received, Design Professional review time stated above will be extended as necessary to perform proper review. Design Professional will review "mass submittals" based on priority determined by Design Professional after consultation with Owner and Seller.

B. Informational submittals and other similar data are for Design Professional's information, do not require Design Professional's responsive action, and will not be reviewed or returned with comment.

C. Submittals made by Seller that are not required by Contract Documents may be returned without action.
D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order.

E. Except for Informational Submittals where no action and return of submittals is required, the Design Professional shall review each submittal, mark to indicate the action taken, and return.

F. Action stamp: The Design Professional will stamp each submittal with a uniform action stamp. The Design Professional will mark the stamp appropriately to indicate the action taken, as follows:
   1. Reviewed (R): Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final acceptance will depend on that compliance.
   2. Review as Noted (RAN): Work covered by the submittal may proceed provided it complies with both the Design Professional's notations and/or corrections on the submittal and requirements of the Contract Documents. Final acceptance will depend on that compliance.
   3. Revise and Resubmit (R&R): Do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the Design Professional's notations. Resubmit without delay. Repeat if necessary to obtain an “R” or “R&R” action mark.
   4. No Action Required (NAR): When a submittal is primarily for information or record purposes, or for special processing or other Seller activity, the submittal will be marked "No Action Required” and returned without review.

1.9. SUBMITTAL SCHEDULE

A. Reference the accompanying Shop Drawing and Submittal Log at the end of this section for required submittal information.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION
## SHOP DRAWING AND SUBMITTAL LOG

**Project:** Power Plant Cooling Tower Replacement  
**Contract:** P-01 Cooling Tower Procurement  
**Project Number:** UNI-CP000279  
**Seller:**

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<td>23 65 00</td>
<td>Cooling Towers</td>
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| 1.3 A | Submittals required with Proposal:  
2. Seller's qualification data required under 1.5 QUALIFICATIONS below.  
3. Tower performance curves:  
   Provide performance curves showing flow (GPM), tower inlet/outlet temperatures (°F), and wet bulb temperature (°F) at 100, 75, 50, and 25% load.  
4. Certified sound performance data, including sound pressure levels by octave band and overall A-weighted sound pressure level at 100, 75, 50, and 25% load as measured at distances prescribed under paragraph 1.10 NOISE GUARANTEES.  
5. Evaporation rate, drift rate, and blowdown rate: Provide evaporation rate (GPM), drift rate (GPM), and corresponding blowdown rate.  
6. General arrangement Drawings:  
   Provide general arrangement drawings showing plan and elevation views with all critical dimensions, weights, loads, required clearances, components, and location and size of all field connections.  
6. Provide equipment and accessories layout and provide areas under the fan deck for cooling tower fan motor supply, instruments, and control cables. Provide details on conduit supports under the deck and entrance locations in the side of the tower coordinated with all access | | | | | | | | | | | |
and maintenance spaces.

7. Motor data clearly identifying features and construction in conformance with Specifications.

8. Tower delivery schedule:
   a. Shop Drawing completion for review by Design Professional and Owner.
   b. Equipment FOB University of Northern Iowa Power Plant, Cedar Falls, IA.
   c. Include expected milestone dates.

### 1.3 B

**Submittals during Engineering and Shop Drawing Production Phase:**

1. Certified cooling tower data sheets.
2. Bill of materials.
3. Certified tower performance curves: Provide performance curves showing flow (GPM), tower inlet/outlet temperatures (°F), and wet bulb temperature (°F) at 100, 75, 50, and 25% load.
4. Certified sound performance data, including sound pressure levels by octave band and overall A-weighted sound pressure levels at 100, 75, 50, and 25% load as measured at distances prescribed under paragraph 1.10 NOISE GUARANTEES. Provide sound curves demonstrating compliance with noise criteria.
5. Evaporation rate, drift rate, and blowdown rate: Provide evaporation rate (GPM), drift rate (GPM), and corresponding blowdown rate.
6. Fan performance data and curves: Provide fan performance data and curves showing rated capacities, pressure drop, fan performance, and rating curves with selected points indicated.
7. Mechanical equipment Drawings: Provide Drawings of mechanical
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<td>8.</td>
<td>Certified general arrangement Drawings: Provide certified general arrangement Drawings showing plan and elevation views with all critical dimensions, weights, loads, required clearances, components, and location and size of all field connections.</td>
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<td>9.</td>
<td>Seller’s (Manufacturer’s) installation instructions and Drawings: Provide for all equipment furnished.</td>
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<td>10.</td>
<td>Tower lifting and rigging recommendations: Drawing of tower “lift rigging” recommendations showing proper sizing of spreader bar, locations of pre-installed lifting brackets, and final leveling instructions.</td>
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<td>11.</td>
<td>Tower foundation, anchor, and support details: Location of tower supports, anchoring details, and information required for foundation design including, but not limited to, reactions, loading, forces, recommended foundation details, etc.</td>
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<td>12.</td>
<td>Motor data clearly identifying features and construction in conformance with Specifications.</td>
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<td>13.</td>
<td>Electrical wiring diagrams for each cooling tower cell makeup water control, including control cabinet layout, wiring diagrams, control schematics, enclosure Bill of Materials with OEMs identified, and OEM part numbers.</td>
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<td>List of any known harmonic frequencies to be locked out for variable-frequency drive (VFD).</td>
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<td>15.</td>
<td>Instrument data sheets including catalog cut sheets for all instruments included within this section.</td>
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<td>16.</td>
<td>Recommended lubricants list for fan gear speed reducers (as applicable).</td>
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<td>17.</td>
<td>Warranty and Seller’s maintenance service agreement data and costs.</td>
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1.3 C Submittals during Close-out Phase (Following Commissioning and startup):  
1. Operation and maintenance data: Submit complete operations and maintenance data including, but not limited to, copies of all Shop Drawings and test reports, inspection period, start-up instructions, maintenance data, parts list, lubrication, drive replacement, wiring diagrams, and recommended cleaning materials and methods.  
2. Seller's certificate: Certify cooling tower performance meets or exceeds specified requirements.  
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<th>Section</th>
<th>Description</th>
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<td>e. Document participation of and results from functional performance testing.</td>
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<td>5. Spare parts list with line item price list for each part.</td>
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<td>6. Service agreement documentation and service organization with local contact information.</td>
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<td>7. Warranty data.</td>
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END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control.
B. Tolerances.
C. References.
D. Labeling.
E. Seller's field services.

1.2 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, and workmanship to produce work of specified quality.
B. Comply with specified standards as the minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
C. Perform work using persons qualified to produce required and specified quality.
D. Products, materials, and equipment may be subject to inspection by Design Professional and Owner at place of manufacture or fabrication. Such inspections shall not relieve Seller of responsibility of complying with requirements of Contract Documents.
E. Supervise performance of work in such manner and by such means to ensure that work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.
B. Comply with Seller's recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Design Professional before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
B. Conform to reference standard by date of issue that is current as of date of Contract Documents except where specific date is established by code.
C. Obtain copies of standards when required by product Specification sections.
D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Design Professional before proceeding.
1.5 LABELING

A. Attach label from agency approved by authorities having jurisdiction over products, assemblies, and systems required to be labeled.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

C. Seller's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in interior or exterior public areas.

1.6 SELLER'S FIELD SERVICES

A. When specified in individual Specification sections, Seller shall provide qualified Field Technical Advisor to observe site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, commissioning and training as applicable, and to initiate instructions when necessary.

B. Submit qualifications of Seller's Field Technical Advisor to Design Professional 30 days in advance of required observations. Seller's Field Technical Advisor is subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.
B. Starting of systems.
C. Demonstration and instructions.
D. Project record documents.
E. Spare parts and maintenance products.
F. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire work or for portions of work:
   1. Submit maintenance manuals, Project record documents, and other similar final record data in compliance with this section.
   2. Participate in facility startup, testing, and commissioning of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this section.
   3. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.

B. Substantial Completion Inspection:
   1. When Seller considers work to be substantially complete, submit to Owner:
      a. Written certificate that work, or designated portion, is substantially complete.
      b. List of items to be completed or corrected (initial punch list).
   2. Within 14 days after receipt of request for Substantial Completion, Design Professional and Owner's Representative will make inspection to determine whether work or designated portion is substantially complete.
   3. Should Design Professional or Owner's Representative determine that work is not substantially complete:
      a. Owner's Representative will promptly notify Seller in writing, stating reasons for its opinion.
      b. Seller shall remedy deficiencies in work and send second written request for Substantial Completion to Owner.
      c. Design Professional and Owner's Representative will re-inspect work.
      d. Redo and Inspection of Deficient Work: Repeated until work passes Design Professional’s and Owner’s Representative’s inspection.
   4. When Owner finds that work is substantially complete, Owner will:
      a. Prepare Certificate of Substantial Completion accompanied by Seller's list of items to be completed or corrected as verified and amended by Design Professional and Owner (final punch list).
      b. Submit Certificate to Owner and Seller for their written acceptance of responsibilities assigned to them in Certificate.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
   1. When Seller considers work to be complete, submit written certification that:
      a. Contract Documents have been reviewed.
      b. Work has been examined for compliance with Contract Documents.
      c. Work has been completed according to Contract Documents.
d. Work is completed and ready for final inspection.

2. Submittals: Submit following:
   a. Final punch list indicating all items have been completed or corrected.
   b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
   d. Accounting statement for final changes to Contract Sum.
   e. Seller's affidavit of payment of debts and claims.
   f. Seller affidavit of release of liens.
   g. Consent of surety to final payment.

3. Perform final cleaning for Seller-soiled areas according to this section.

D. Final Completion Inspection:
   1. Within 14 days after receipt of request for final inspection, Design Professional and Owner’s Representative will make inspection to determine whether work or designated portion is complete.
   2. Should Design Professional or Owner’s Representative consider work to be incomplete or defective:
      a. Owner’s Representative will promptly notify Seller in writing, listing incomplete or defective work.
      b. Seller shall remedy stated deficiencies and send second written request to Design Professional and Owner’s Representative that work is complete.
      c. Design Professional and Owner’s Representative will reinspect work.
      d. Redo and Inspection of Deficient Work: Repeated until work passes Design Professional’s and Owner’s Representative’s inspection.

1.3 STARTING OF SYSTEMS

A. Coordinate schedule for startup of various equipment and systems.

B. Notify Design Professional and Owner’s Representative 14 days prior to startup of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute startup under supervision of manufacturer’s representative or Seller’s personnel according to manufacturer’s instructions.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two (2) weeks prior to date of Substantial Completion.

B. Provide training for Owner’s operation and maintenance personnel in accordance with the requirements of Section 23 65 00 – Cooling Towers.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.

D. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

F. Required instruction time for each item of equipment and system is specified in individual Specification sections.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain one (1) set of the following record documents; record actual revisions to the work:
   1. Specifications.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.
   4. Reviewed Shop Drawings, product data, and Samples.
   5. Seller's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product section, description of actual products installed, including the following:
   1. Seller's name and product model and number.
   2. Product substitutions or alternates used.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
   1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the work, and change orders.
   2. Include locations of concealed elements of the work.
   3. Field changes of dimension and detail.
   4. Details not on original Drawings.

1.6 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification sections.

1.7 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within 10 days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Submit prior to final Application for Payment.
PART 2 PRODUCTS
NOT USED

PART 3 EXECUTION
NOT USED

END OF SECTION
SECTION 01 78 23
OPERATION AND MAINTENANCE MANUAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Format and content of Operation and Maintenance (O&M) Manuals.

B. Requirements for training of Owner personnel.

C. Schedule of deliverables.

1.2 RELATED REQUIREMENTS

A. The following sections contain related requirements:
   1. Section 01 33 23 – Submittals.
   2. Section 01 70 00 – Execution and Closeout Requirements.
   3. Specific product, equipment, and assembly technical sections.

B. Refer to ASHRAE Guideline 4 current edition for standard of care and definitions.

1.3 GENERAL REQUIREMENTS

A. The O&M Manuals shall be organized as a practical, actionable guide to achieve the following:
   1. Provide instructions for the safe, efficient, and sustainable use of the facility, system(s), and component(s).
   2. Provide the basis for training Owner personnel.
   3. Provide the basis for establishing maintenance programs for optimal system(s) and component(s) lifecycle.
   4. Provide the technical information required for the maintenance, repair, etc. of system(s) and component(s).
   5. Provide a record of as-installed setpoints, sequences, and operating conditions of system(s) and component(s).

B. The following items are not to be included in the O&M Manual:
   1. Warranties.
   2. Testing, Adjusting, and Balancing Report(s).

1.4 O&M MANUAL CONTENTS

A. Each O&M Manual shall include the following tabs:
   1. Table of Contents Tab:
      a. Include all tab and section information.
   2. Project Information Tab:
      a. Owner’s Representative’s name.
      b. Design Professional and Professional Consultant names, addresses, and telephone numbers.
      c. Supplier’s name, address, and telephone numbers.
      d. Subcontractors List.
   3. Warranty Summary Tab:
      a. Provide a list of all extended warranties. Refer to Specification Section 01 70 00 – Execution and Closeout Requirements.
      b. Copies of the warranties shall be submitted per Specification Section 01 70 00 – Execution and Closeout Requirements.
   4. System and Component Tab (Multiple tabs):
      a. Arrange contents by building system(s) and component(s). At a minimum, provide an individual tab for each system and component identified in this section.
      b. The following system(s) and component(s) shall each have an individual tab within the O&M Manual. Owner may edit list based upon submittals and
approval of system(s) and component(s):
1) Section 23 65 00 – Cooling Towers.

1.5 SYSTEM AND COMPONENT TAB CONTENTS

A. Each system and component tab shall be organized and arranged as outlined below.

1. General Information Section:
   a. System and component designation (as per Contract Documents).
   b. Component (product) CSI Specification number.
   c. Component (product) nameplate data:
      1) Manufacturer.
      2) Model number.
      3) Serial number.
      4) Size.
      5) Horsepower.
      6) Voltage and amperage.
   d. Location within facility (i.e. room).
   e. Installing contractor contact information with phone number.
   f. Emergency or service contact information with phone number.
   g. Customer service and parts contact information with phone number and website.

2. Safety Precautions:
   a. Definition.
   b. General Safety Regulations.
   c. Warning Labels.
   d. Emergency and Safety Devices.
   e. Description of Inherent Dangers.

3. Inspection and Transport:
   a. Inspection.
   b. Storage.
   c. Lifting and Transport.
   d. Unpacking.

4. Sequence of Operations Section:
   a. As-built (as-installed) narratives and sequence of operations for:
      1) Normal/auto operations mode.
      2) Manual/non-auto operations mode.
      3) Fail/emergency operations mode.
   b. As-built Control(s) diagrams.

5. Testing and Training Section:
   a. Seller's Startup Report(s).
   b. Functional Test Reports.
   c. Training Materials.

6. Component (Product) and Operations Information Section:
   a. Seller's installation instructions.
   b. Seller's startup and troubleshooting instructions.
   c. Seller's technical instructions.
   d. Seller's operations instructions.
   e. Parts list (Special tools and maintenance equipment).
   f. Wiring diagrams (if applicable).
   g. Valve Schedule.

7. Maintenance Information Section:
   a. Preventative maintenance schedule recommendations.
   b. Seller's lubrication schedule and list of acceptable lubricants.
   c. Seller's care and cleaning instructions.
   d. Spare parts list.

1.6 O&M MANUAL FORMAT

A. Hard Copy Format:
   1. Hard Copy Format O&M Manuals shall be bound using heavy duty, D-ring binders, maximum size 3".
UNIVERSITY OF NORTHERN IOWA
POWER PLANT COOLING TOWER REPLACEMENT
P-01 COOLING TOWER PROCUREMENT

2. Each binder shall be identified on the front and spine with the following:
   a. Owner Purchase Order or Contract Number - Project Name.
   b. OPERATION AND MAINTENANCE MANUAL.
   c. Volume # of #.
3. O&M Manual page sizes may be 8.5" x 11" or 11" x 17". Oversized Drawings shall be inserted into punched vinyl pockets when necessary.

B. Electronic Format:
   1. Electronic file shall be searchable, fully bookmarked .pdf.
      a. Bookmark the .pdf file by tabs listed under Section 1.4 and sub-bookmark system and component tab by section as listed under Section 1.5.
   2. File name shall be as follows:
      a. Owner Project No. - Company Name-O&M Manual-Vol#of#.

1.7 O&M MANUAL DELIVERABLES

A. 50% Construction O&M Manual Deliverable:
   1. The Seller shall submit to the Design Professional one (1) electronic copy of the 50% Construction O&M Manual(s) prior to submission of its pay application requesting payment of 50% of the Contract value or more.
   2. Payments beyond 50% of the Contract amount may be withheld until the 50% Construction O&M Manuals are reviewed and accepted.
   3. The requirements for the 50% Construction O&M Manual deliverable shall be as follows:
      a. Table of contents tab complete.
      b. Project information tab complete.
      c. Warranty Summary.
      d. System and component tab(s):
         1) Article 1.5, Section 1 complete.
         2) Article 1.5, Section 4 complete.
         3) Article 1.5, Section 5 complete.

B. Training O&M Manual Deliverable:
   1. The Seller shall submit to the Design Professional one (1) electronic copy of the Training O&M Manual(s) prior to Owner training.
   2. The requirements for the Training O&M Manual deliverable shall be as follows:
      a. Table of contents tab complete.
      b. Project information tab complete.
      c. Warranty Summary.
      d. System and component tab(s):
         1) Article 1.5, Section 1 complete.
         2) Article 1.5, Section 3 complete.
         3) Article 1.5, Section 4 complete.
         4) Article 1.5, Section 5 complete.

C. Final O&M Manual Deliverable:
   1. The Seller shall submit one (1) electronic and three (3) hard copies of the Final O&M Manual to Design Professional for review and comment prior to Final Completion.
   2. The requirements for the Final O&M Manual deliverable shall be as follows:
      a. Table of contents tab complete.
      b. Project information tab complete.
      c. Warranty Summary complete.
      d. System and component tab(s):
         1) Article 1.5, Section 1 complete.
         2) Article 1.5, Section 2 complete.
         3) Article 1.5, Section 3 complete.
         4) Article 1.5, Section 4 complete.
         5) Article 1.5, Section 5 complete.
   3. The Seller shall submit one (1) copy of AutoCAD/Visio editable files for all "Construction Record" control as-built Drawings indicated herein:
a. Control Drawings with detailed piping and wiring diagrams, bill of materials and Sequence of Operations for each system, including interfaces with equipment manufacturers, and other suppliers of equipment and systems.

b. I/O panel layouts and terminations along with interface panel Drawings.

c. Valve and Damper Schedules showing size configuration, capacity, failure position, and location of all equipment.

d. Individual data sheets for each control and automation system’s components.

e. Termination and Ladder wiring diagrams.

f. Small-scale site and equipment plans showing the control component locations in occupied space, equipment rooms, mechanical equipment, etc.

1.8 TRAINING OF OWNER’S PERSONNEL

A. Scheduling and Coordination:

1. All training shall be completed prior to Substantial Completion.

2. Submit proposed training schedule to Owner’s Representative a minimum of 90 days prior to Substantial Completion. Seller’s proposed training schedule shall include the following:

   a. Proposed dates for training by system and component.
   b. Location of the training; classroom or onsite.
   c. Name and role of trainer.
   d. Detailed agenda for session(s).
   e. Draft of training materials including an outline of the specific skills or knowledge the Owner’s Personnel is expected to master.

3. Training schedule shall be adjusted as required to minimize disruption to Owner’s operations. Provide training sessions outside of normal working hours as required for Owner’s personnel.

B. Training Content:

1. Refer to technical Specification sections for additional training requirements.

2. Training O&M Manual shall be used as the basis for instruction.

3. By Substantial Completion provide the Owner all specialty tools, keys, pass codes, or other items required for the operation or maintenance of system(s) and component(s).

4. Each training session shall include a thorough review of the following, as applicable:

   a. General Information Section, Section 1.5.
   b. Operations Information:
      1) Overview of system(s) and component(s) including primary and secondary functions, as-built sequence of operations, area served, and system limitations.
      2) Standard operating procedures for:
         i. Normal system(s) and component(s) startup and shutdown.
         ii. Normal, manual, and automatic operations.
         iii. Seasonal, intermittent, or non-occupied operations.
         iv. Emergency or failure conditions including the meaning of warning, trouble, and error messages.
      3) Special tools and maintenance equipment.
      4) Startup and troubleshooting instructions.
   c. Maintenance Information:
      1) Maintenance Information Section, Section 1.5.
      2) Component access.
      3) Alignment, tension, vibration, and noise criteria and adjustments.
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PART 1 GENERAL

1.1 SUMMARY

A. Section includes complete factory-assembled, packaged, induced-draft, crossflow cooling tower cells, including but not limited to:
   1. Structure, casing, walls, and fan deck.
   2. Fan shroud.
   3. Mechanical equipment, including fan, drive, and driveshaft.
   4. Electric motors.
   5. Heat transfer media (fill).
   6. Drift eliminators.
   7. Hot water distribution system.
   8. Hot water and cold water basins.
   9. Access and safety appurtenances, including stairs, ladders, access doors, etc.
   10. Accessories, including site glasses, instrumentation, etc.

B. Provide all labor, materials, equipment, transportation, coordination, and facilities necessary for the proper execution of the Power Plant Cooling Tower Replacement Project, Contract P-01 – Cooling Tower Procurement, including any adjustments needed to meet performance standards.

C. Three (3) cooling tower cells shall be installed on new structure over an existing concrete basin.

D. Three (3) cooling tower cells shall be arranged as shown on enclosed GA10 General Arrangement – Cooling Tower and GA20 General Arrangement – Sections.

E. Owner reserves the right to clarify and/or modify cooling tower requirements specified herein based upon the operational and maintenance needs of the University of Northern Iowa. Such notification will be provided in writing to prospective bidders.

1.2 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
   2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Civil Engineers (ASCE):

C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

D. American Society of Mechanical Engineers (ASME):
   1. ASME PTC 23 – Atmospheric Water Cooling Equipment.

E. American Society for Testing and Materials (ASTM) International:
   5. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A666/A666M – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

F. Cooling Technology Institute (CTI):
5. CTI STD-111 – Gear Speed Reducers for Application on Industrial Water Cooling Towers.

G. Factory Mutual Insurance Standards.

H. National Electrical Manufacturers Association (NEMA):
1. NEMA 250 – Enclosures for Electrical Equipment (1,000 Volts Maximum).
2. NEMA MG-1 – Motors and Generators.

I. National Fire Protection Agency (NFPA):

J. Underwriters Laboratories, Inc. (UL) Standards.

1.3 SUBMITTALS

A. Submittals required with Proposal:
2. Seller’s qualification data required under 1.5 QUALIFICATIONS below.
3. Tower performance curves: Provide performance curves showing flow (GPM), tower inlet/outlet temperatures (°F), and wet bulb temperature (°F) at 100, 75, 50, and 25% load.
4. Certified sound performance data, including sound pressure levels by octave band and overall A-weighted sound pressure level at 100, 75, 50, and 25% load as measured at distances prescribed under paragraph 1.10 NOISE GUARANTEES.
5. Evaporation rate, drift rate, and blowdown rate: Provide evaporation rate (GPM), drift rate (GPM), and corresponding blowdown rate.
6. General arrangement Drawings: Provide general arrangement Drawings showing plan and elevation views with all critical dimensions, weights, loads, required clearances, components, and location and size of all field connections.
7. Provide equipment and accessories layout and provide areas under the fan deck for cooling tower fan motor supply, instruments, and control cables. Provide details on conduit supports under the deck and entrance locations in the side of the tower coordinated with all access and maintenance spaces.
8. Motor data clearly identifying features and construction in conformance with Specifications.
9. Tower delivery schedule:
   a. Shop Drawing completion for review by Design Professional and Owner.
   b. Equipment FOB University of Northern Iowa Power Plant, Cedar Falls, IA.
   c. Include expected milestone dates.

B. Submittals during Engineering and Shop Drawing Production Phase:
1. Certified cooling tower data sheets.
2. Bill of materials.
3. Certified tower performance curves: Provide performance curves showing flow (GPM), tower inlet/outlet temperatures (°F), and wet bulb temperature (°F) at 100, 75, 50, and 25% load.
4. Certified sound performance data, including sound pressure levels by octave band and overall A-weighted sound pressure levels at 100, 75, 50, and 25% load as measured at distances prescribed under paragraph 1.10 NOISE GUARANTEES. Provide sound curves demonstrating compliance with noise criteria.
5. Evaporation rate, drift rate, and blowdown rate: Provide evaporation rate (GPM), drift rate (GPM), and corresponding blowdown rate.
6. Fan performance data and curves: Provide fan performance data and curves showing rated capacities, pressure drop, fan performance, and rating curves with selected points indicated.
7. Mechanical equipment Drawings: Provide Drawings of mechanical equipment including information on fan blades, drive, drive shaft, and fan hub. Drawings shall indicate blade pitch recommendations, installation, troubleshooting, and operation requirements.
8. Certified general arrangement Drawings: Provide certified general arrangement Drawings showing plan and elevation views with all critical dimensions, weights, loads, required clearances, components, and location and size of all field connections.
9. Seller’s (Manufacturer’s) installation instructions and Drawings: Provide for all equipment furnished.
10. Tower lifting and rigging recommendations: Drawing of tower “lift rigging” recommendations showing proper sizing of spreader bar, locations of pre-installed lifting brackets, and final leveling instructions.
11. Tower foundation, anchor, and support details: Location of tower supports, anchoring details, and information required for foundation design including, but not limited to, reactions, loading, forces, recommended foundation details, etc.
12. Motor data clearly identifying features and construction in conformance with Specifications.
13. Electrical wiring diagrams for each cooling tower cell makeup water control, including control cabinet layout, wiring diagrams, control schematics, enclosure Bill of Materials with OEMs identified, and OEM part numbers.
14. List of any known harmonic frequencies to be locked out for variable-frequency drive (VFD) operation.
15. Instrument data sheets including catalog cut sheets for all instruments included within this section.
16. Recommended lubricants list for fan gear speed reducers (as applicable).
17. Warranty and Seller’s maintenance service agreement data and costs.
18. Updated tower delivery schedule:
   a. Equipment FOB University of Northern Iowa Power Plant, Cedar Falls, IA.
   b. Include expected milestone dates.

C. Submittals during Close-out Phase (Following Commissioning and startup):
1. Operation and maintenance data: Submit complete operations and maintenance data including, but not limited to, copies of all Shop Drawings and test reports, inspection period, start-up instructions, maintenance data, parts list, lubrication, drive replacement, wiring diagrams, and recommended cleaning materials and methods.
2. Seller’s certificate: Certify cooling tower performance meets or exceeds specified requirements.
4. Field reports:
   a. Field supervision and inspection reports.
   b. Document confirmation of pre-installation verification checklists.
   c. Document confirmation of pre-start-up verification checkout.
   d. Document participation of and results from start-up testing verification.
   e. Document participation of and results from functional performance testing.
5. Spare parts list with line item price list for each part.
6. Service agreement documentation and service organization with local contact information.
7. Warranty data.

1.4 QUALITY ASSURANCE
A. Cooling tower shall meet the requirements of CTI STD-201.
B. Thermal performance and capacity in accordance with CTI ATC-105.
C. Performance ratings: Required performance not less than prescribed by ASHRAE 90.1 when tested in accordance with CTI ATC-105.
D. Cooling tower shall be rated in accordance with Factory Mutual fire rating standards and shall be listed in the latest edition of the FM Approval Guide.
E. All equipment, materials, accessories, and components provided shall have an acceptable history of reliable service in central chilled water plant applications for a period of at least three (3) years at similar operating conditions (i.e. pressure, stress, temperature, and flow rates).
F. Complete all recommended factory tests on equipment and materials. Submit test reports to Owner.
G. Provide confirming documentation (test report) from an accredited test agency that cooling tower fire walls meet the requirements of NFPA 214 and test procedures outlined in NFPA 251 or ASTM E119 as applicable.
H. Motors, instrumentation, and wiring provided by Seller shall be approved and listed by Underwriters Laboratory (UL).

1.5 QUALIFICATIONS
A. Seller shall specialize in manufacturing of cooling towers specified in this section with minimum 10 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver equipment, materials, accessories, and components to site for uninterrupted progress of Work.
B. All pipe nozzle connections shall be capped/plugged to prevent ingress of foreign materials and moisture.

C. Equipment, components, and materials shall be protected from corrosion for entire duration of shipment from factory to FOB job site. Equipment, components, and materials shall be delivered to site in clean, corrosion-free, undamaged condition.

D. If equipment and components are shipped during ambient conditions below 32°F, equipment and components shall be bag or plastic wrapped.

E. Do not telescope small pipe inside larger pipe for shipment or storage.

1.7 FIELD MEASUREMENTS

A. Seller shall verify all field dimensions prior to fabrication of materials and components.

1.8 COOLING TOWER DESIGN PARAMETERS

A. Tower shall be comprised of three (3) cells adjacent to each other. Each cell shall have a maximum width of 22'-6" and a maximum length of 14'-0".

B. The maximum height (to the top of the fan shroud) shall be 20'-0". Height is measured from cooling tower steel level.

C. Cooling tower structure, components, and anchorage shall be designed to meet the requirements of the International Building Code, ASCE 7-10, Occupancy Category III, all CTI Guidelines or the following requirements, whichever are more stringent:

1. Wind load: Tower shell shall be designed for wind loading per ASCE 7-10. Parameters for wind load calculation are as follows:
   a. Basic wind speed (V): 120 mph.
   b. Wind directionality factor (K_d): 0.9.
   c. Exposure category: C.
   d. Topographic factor (K_z): 1.0.
   e. Gust effect factor (G): 0.85.
   f. Internal pressure coefficient (GC_pl): ± 0.18.

2. Snow load: Structures, along with all components, shall be designed for snow load in accordance with ASCE 7-10. Parameters for snow load calculations are as follows:
   a. Ground snow load (pg): 30 psf.
   c. Thermal factor (C_t): 1.2.
   d. Exposure factor (C_e): 1.10.

3. Seismic load: Structures, along with all components, shall be designed for seismic loads in accordance with ASCE 7-10. Parameters for seismic loading calculations are as follows:
   a. Seismic design category: B.
   b. Site class: D.

4. Live loads:
   a. Maintenance platforms, walkways, fan deck, staircases, ladders, and basin covers (where/if applicable) shall be designed for a minimum live load of 60 psf and a 200-pound concentrated load.
   b. Fills and fill supports shall be designed for a minimum live load of 40 psf and a 200-pound concentrated load.
   c. Handrails and guardrails shall be designed for a minimum 200-pound concentrated load applied in any direction at any point along the top rail and be in accordance with OSHA guidelines.

5. Dead loads:
a. Fills and fill supports shall be designed for a dead weight equal to the dry weight of fill, water hold-up weight, and a 15% allowance for clogging.
b. Drift eliminators and supports shall be designed for a dead weight equal to the dry weight of drift eliminators and the weight of the water eliminated from air discharge.

6. All access equipment (platforms, ladders, guardrails) shall be in accordance with OSHA guidelines.

1.9 PERFORMANCE GUARANTEES

A. Seller shall guarantee cooling tower cell(s) shall meet the specified capacity and thermal performance criteria as defined in the table below when operated at the site, and in accordance with Seller’s recommendations for the project-specific location, arrangement, and limitations.

<table>
<thead>
<tr>
<th>Cooling Tower Performance Guarantees (Per Cell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Fans</td>
</tr>
<tr>
<td>Condenser Water Flow Rate</td>
</tr>
<tr>
<td>Entering air wet bulb temperature</td>
</tr>
<tr>
<td>Condenser Water Supply (Outlet) Temperature</td>
</tr>
<tr>
<td>Condenser Water Return (Inlet) Temperature</td>
</tr>
<tr>
<td>Head Loss*</td>
</tr>
<tr>
<td>Maximum Drift (% of Design Flow)</td>
</tr>
<tr>
<td>Motor Power</td>
</tr>
<tr>
<td>Motor Speed</td>
</tr>
<tr>
<td>Electrical</td>
</tr>
</tbody>
</table>

* Head loss includes both elevation head and friction loss due to cooling tower and components. Elevation head shall be as measured from the basin water level to the inlet discharge to hot water basin.

G – Guarantee Value

B. Cooling tower(s) shall be Cooling Technology Institute (CTI) certified as set forth in the CTI certification Standard STD-201. Cooling tower(s) claiming to be CTI “listed” or “designed” to CTI Specifications shall not be acceptable.

C. Cooling tower shall be capable of continuous operation during freezing conditions. Winter design conditions shall be per 2013 ASHRAE Fundamentals Weather Data for Cedar Falls, IA.

1.10 NOISE GUARANTEE

A. Seller shall guarantee the sound pressure levels (SPL) shall be equal to or less than the lower of the following:

1. In accordance with the following octave band table at a distance of 5 feet from the tower at the location indicated.

<table>
<thead>
<tr>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Air Inlet</td>
</tr>
<tr>
<td>Fan Discharge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Air Inlet</td>
</tr>
<tr>
<td>Fan Discharge</td>
</tr>
</tbody>
</table>
2. In accordance with the following octave band table at a distance of 50 feet from the tower at the location indicated.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Location</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Inlet</td>
<td></td>
<td>76</td>
<td>68</td>
<td>70</td>
<td>67</td>
<td>65</td>
</tr>
<tr>
<td>Fan Discharge</td>
<td></td>
<td>80</td>
<td>76</td>
<td>76</td>
<td>82</td>
<td>69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Location</th>
<th>2,000</th>
<th>4,000</th>
<th>8,000</th>
<th>dB(A)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Inlet</td>
<td></td>
<td>64</td>
<td>54</td>
<td>45</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Fan Discharge</td>
<td></td>
<td>69</td>
<td>65</td>
<td>60</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

B. Seller shall provide, indicate, and include any sound-attenuation devices required to meet the noise criteria with bid.

1.11 WATER QUALITY

A. Cooling tower shall be capable of operating with makeup water supplied from the Owner's water system taken from the Well Water and treated. Water quality shall be based upon the "Typical Water Analysis" completed by NALCO and enclosed with this section.

B. Cooling tower shall be capable of operating with maximum cycles of concentration of four (4) and the water quality based upon the following:
   1. Calcium (CaCO3): 1.9 mg/L maximum.
   2. Chloride: 1.3 mg/L.
   3. Sulfate (SO4): 15.0 mg/L.
   4. Silica (SiO2): 13.0 mg/L.
   6. Total dissolved solids (TDS): 800 mg/L maximum.
   7. pH: 8.1 to 8.4.

C. Owner's cooling tower water treatment program consists of the following chemicals used for the control of scale, pH, corrosion, and biological fouling.
   1. Nalco 3D TRASAR™ 3DT132 Corrosion Inhibitor.
   2. Nalco NALSPERSE™ 7348 Biodispersant.
   3. Performax™ CC6203 Corrosion Inhibitor.
   4. Sodium Hypochlorite (12.5%).
   5. Sulfuric Acid (66%).

1.12 WARRANTY

A. Provide five (5) year warranty for all labor and materials associated with the cooling tower. Warranty shall start upon beneficial operation of the cooling tower or substantial completion, whichever occurs first.

1.13 EXTRA MATERIALS

A. Maintenance lubricants: Furnish lubricants required for initial operation. Lubricant shall be as recommended by the drive manufacturer.

B. Spare spray nozzle: Furnish one (1) spare spray nozzle for each cooling tower cell (as applicable).

C. Special tools: Provide a complete set of any special tools required for normal operation and maintenance.
PART 2 PRODUCTS

2.1 ACCEPTABLE COOLING TOWER SELLERS (MANUFACTURERS)

A. SPX Cooling Technologies, Inc. (Marley) NC 8400 Series.

2.2 COOLING TOWER STRUCTURE

A. Constructed with heavy-duty structural frame designed to transmit all wind, seismic, snow, and live loads to equipment anchorage.
B. Framing: Rolled or formed structural stainless steel in accordance with ASTM A666, Type 304 or Type 301L.
C. Hardware: Series 300 stainless steel nut and bolt fasteners.
D. Welded connections: Continuous and watertight.

2.3 CASING AND WALLS

A. Cooling tower casing: Constructed of heavy gage (minimum 16 gage) Type 304 or Type 301L stainless steel panels in accordance with ASTM A666.
B. Joints and seems: Sealed watertight.
C. Welded connections: Continuous and watertight.
D. Fasteners: Series 300 stainless steel nut and bolt fasteners. Use stainless steel washers and neoprene backing where required to prevent leaks.

2.4 FAN DECK

A. The cooling tower fan deck shall be fabricated from Type 304 or Type 301L stainless steel in accordance with ASTM A666.
B. The top surface of the deck shall have a factory-coated, skid-resistant surface applied for added operator safety.
C. Fan deck shall not protrude into the fan shroud opening more than 1”.
D. Fasteners: Series 300 stainless steel nut and bolt fasteners. Use stainless steel washers and neoprene backing where required to prevent leaks.

2.5 MECHANICAL EQUIPMENT

A. Cooling tower fans:
   1. Cooling tower fans shall be adjustable pitch, multi-blade, axial flow, propeller type selected to deliver the design air flow at maximum efficiency and provide long life when handling saturated air at high velocities.
   2. Fan shall consist of an odd number of fan blades with the minimum of five (5) blades used. The fan blade material shall be constructed of aluminum alloy.
   3. Fan hub shall be constructed of hot-dipped galvanized steel per ASTM A123.
   4. An air seal disc shall be provided to prevent recirculation of the air at the fan hub.
   5. Cooling tower fan shall be statically and moment balanced and have a maximum tip speed of 12,000 feet per minute.
   6. Fan shall be capable of operating in reverse rotation for up to 50% of full speed.
   7. Fan hardware shall be Series 300 stainless steel.
B. Gear speed reducers:
1. Fan drive shall be geared, right-angle, speed-reduction type, in accordance with AGMA standards for Class II 24-hour continuous duty with shock load for cooling tower service rated in accordance with CTI STD-111, or at 2.0 times motor-rated horsepower, whichever is more stringent.
2. Gear speed reducers shall be rigidly mounted to maintain permanent alignment. Mounting shall be capable of withstanding shock loading due to application of brakes and reversing of fans.
3. Gear speed reducers shall be capable of operating in reverse rotation.
4. Bearings shall be ball or tapered roller for radial and thrust load in accordance with ABMA 9 or ABMA 11 for a minimum L-10 life expectancy of 80,000-hours.
5. Lubrication of oil bath type suitable for continuous operation in forward or reverse rotation.
6. Seller shall pipe lubrication fill and vent lines to outside of the fan shroud and adjacent to the electric motor for convenient access to check oil levels, and to fill and drain the gear case without shutting down cooling tower cell.
7. Lubrication and vent piping shall be stainless steel and adequately supported to prevent vibration.
8. Provide threaded Series 300 stainless steel oil fill, sight glass, drain, and vent piping with lubrication system.

C. Drive shaft:
1. Power shall be transmitted from the motor to the speed reducer by means of a full floating, stainless steel, tubular drive shaft center member supported by non-lubricated, flexible, stainless steel hubs at both ends.
2. The shaft and couplings shall be selected for cooling tower service with a minimum service factor of 2.0.
3. Shaft seals shall be capable of preventing the entrance of water under all operating and non-operating conditions.

2.6 ELECTRIC MOTOR
A. Motor: Variable speed with special moisture protection mounted on welded steel frame on fan deck. The fan motor shall be located outside the saturated air discharge stream.
1. Enclosure: Totally enclosed fan cooled (TEFC).
2. Service factor: 1.00.
3. Voltage: 460-Volt, 3-phase, 60-Hz service.
4. Insulation class: Class F insulation with a Class B temperature rise.
5. Efficiency: Meet full-load efficiency of energy-efficient motors as defined in NEMA MG-1, Table 12-11.
6. Rating: Motors shall be rated and labeled for inverter duty conforming to NEMA MG-1, Part 31.
7. Ambient temperature: 40°C.
8. Elevation: Less than 3,000' above sea level.
9. Bearings: Motors shall utilize sealed anti-friction bearings, and both drive and non-drive bearings shall be electrically insulated. Provide shaft-mounted grounding brush with copper lead extended to motor frame ground pad.
10. Provide integral motor space heaters wired to a separate junction box, rated 240VAC and intended for operation at 120VAC.
11. Provide moisture-proof neoprene gasket between motor terminal box and motor frame.
12. Provide gasketed motor terminal box.
13. Acceptable Manufacturers:
a. U.S. Motors.
b. Siemens.
c. TECO-Westinghouse.
d. ABB.
e. General-Electric.
2.7 HEAT TRANSFER MEDIA (FILL)

A. The cooling tower cells shall utilize rigid, UV-protected, cellular film-type PVC in accordance with ASTM D3679 and ASTM D1784, Type 1, Grade 1. Fill shall be clog resistant with a minimum thickness of 15 mil and a flute height of ¾”.

B. Fill shall be designed for a maximum temperature of 125°F.

C. Fill shall have a flame spread of 25 or less in accordance with ASTM E84.

D. Fill shall be designed to facilitate even air distribution at circulating water flow rates of 50% to 130% of design flow rate. Note: This is for circulating water and air distribution patterns only and is not a requirement for towers to be rated for 130% of specified performance guarantees.

E. Fill shall be designed for ease of removal, in sections, piece, or grids.

F. Fill shall be supported as required to accommodate installation loads and operational loads defined under “Cooling Tower Design Parameters,” as well as potential ice loads.

2.8 DRIFT ELIMINATORS

A. Each cooling tower shell shall include drift eliminators designed and constructed to remove the maximum free water particles necessary to meet the performance requirements scheduled on the Drawings while having a minimum resistance to airflow.

B. Drift eliminators shall be cellular, triple pass, and constructed impact resistant, UV-protected PVC, in accordance with ASTM D1784 and with a minimum thickness of 17 mils.

C. Drift eliminators shall have a flame spread of 25 or less in accordance with ASTM E84.

D. Drift eliminators shall include a UV inhibitor in accordance with CTI STD-136.

E. Drift eliminators shall be supported as required to accommodate construction loads and operational loads defined under “Cooling Tower Design Parameters.”

2.9 HOT WATER DISTRIBUTION SYSTEM

A. Hot water shall be distributed over the fill in each cell via a gravity-flow distribution system with covered hot water basins and metered orifices.

B. Hot water distribution basins:
   1. Open and gravity fed for easy cleaning.
   2. Constructed of Series 300 stainless steel, in accordance with ASTM A666.
   3. Accessible from outside the unit and serviceable during tower operation.

C. Provide hot water basins with distribution covers constructed of heavy-gauge Series 300 stainless steel and capable of being removed vertically from fan deck and designed to withstand live loads defined under “Cooling Tower Design Parameters.”

D. Gravity flow nozzles:
   1. Removable and interchangeable, constructed of polypropylene and shall provide full heat transfer media (fill) coverage by gravity flow.
   2. Design shall allow for removal and replacement of nozzles while cooling tower is in operation.
   3. Nozzles shall be capable of a variable flow of down to 50% of design flow, while maintaining the uniform airside pressure drop to maximize cooling efficiency and minimize the risk of ice and scale formation in the fill.
E. Piping connection:
   1. All outlet connections shall be suitable to mate with ASME Class 150 flat-faced flanges on piping.
   2. Provide condenser water return (hot water inlet) connection on bottom side of cold water basin.
   3. Provide an internal piping header constructed of PVC to deliver water equally to hot water basins. Piping shall extend to tower exterior surface.
   4. All piping connections shall be located on the bottom of the towers.

F. Hardware: Series 300 stainless steel nut and bolt fasteners.

2.10 COLD WATER BASIN

A. Constructed of ¼" minimum Series 300 stainless steel panels and structural members, welded for water-tight construction. Basin shall be sloped to center. The center of each basin shall have an integral sump with cleanout connection.

B. Slope basin floor toward drain to allow for a complete flush out of debris and dirt from cold water basin.

C. Piping connections:
   1. All outlet connections shall be flanged for ASME Class 150 flat-faced flanges.
   2. Provide condenser water supply (outlet) connection on bottom side of cold water basin as shown on Drawings.
   3. Provide basin overflow and drain connection on bottom side of cold water basin as shown on Drawings.

2.11 ACCESS AND SAFETY

A. Provide for continuous and safe walkway between each cell, including stainless steel platform with handrails to traverse any gap between cells.

B. Provide 300 Series stainless steel rectangular access door located at both solid faces (non-air inlet sides). Access doors shall be 30" x 30" minimum.

C. Provide factory-installed 300 Series stainless steel walkway extending from one side access door to the other side access door. Walkway shall be supported by stainless steel framework and be mounted above the cooling tower cell overflow level.

D. Provide an internal ladder extending upward from the internal walkway to an elevated fiberglass platform for access to mechanical equipment.

E. Provide OSHA-compliant handrails, including kneeboards and toe boards, for fan deck and all Seller-furnished platforms where indicated on Sheets GA10 General Arrangement – Cooling Tower and GA20 General Arrangement – Sections. Handrails shall be supported from columns that are secured to the internal basin floor.

F. Provide external access ladder, constructed of stainless steel, with safety cage for one cell as shown on Sheet GA10 General Arrangement – Cooling Tower. Ladder shall extend from top of concrete basin at grade to an elevation equal in height to the top of the fan deck handrail. Safety cage shall start at 7'-0" above the foot of the ladder.

G. Fan drive and moving parts shall comply with all OSHA guidelines.

H. All hardware, nuts, bolts, and washers shall be Series 300 stainless steel unless otherwise noted.

I. Weld on opposite corners of the cooling tower (total of two [2] each tower) basin stainless steel NEMA two (2) hole grounding pads for connection to the site grounding system.
J. Provide a factory installed NEMA 4X, stainless steel, heavy-duty local motor disconnect switch with early break auxiliary contact that opens before the main conductor blades open on each fan motor to interlock the fan motor VFD. Disconnect switch shall be able to be padlocked, factory installed, and wired to the fan motor, and shall be rated for no less than 65KAIC available fault current. Disconnect switch shall be bottom-entry type with electrical service from below the fan deck. Disconnect shall be physically mounted adjacent to the fan motor. If mounted on an outside handrail, the raceway to the fan motor shall be routed under the fan deck to this location. Raceway between fan starter and fan motor shall be rigid aluminum conduit. Manufacturer: Schneider Electric - Square D.

2.12 ACCESSORIES

A. Vibration cutout switch: A vibration cutout shall be supplied and installed in a protected position and in the most effective location as determined by the supplier. Switch shall be manually remotely resetting, with two (2) sets of DPDT form C contacts. Contacts shall be rated 120VAC, 1A minimum. Vibration cutout switch panel shall be capable of remote mounting on maintenance platform around cooling tower cell. Provide guard wired NEMA 4X remote resetting pushbutton, factory wired to the vibration switch with nameplate. Provide Metrix 440 (440-DR-2X44-0000) electronic vibration switches with NEMA 4 enclosures on each tower cell with remote reset features.

B. Low oil cutout switch: Low oil level cutout switch shall be supplied and installed in a protected position and in the most effective location as determined by the supplier. Oil level switch shall change state when oil level drops below the optimal operating range. Switch shall be manually resetting, with one (1) set of DPDT form C contacts. Contacts shall be rated 120VAC, 1A minimum. Provide Murphy EL-150EX or equal with manual reset external to the fan stack.

C. Provide oil level indication for each gear speed reducer oil fill system to facilitate routine inspection and maintenance. Seller shall list normal operational and out of service oil levels on a name plate near oil level indication, including a level where the low oil switch is set to trip.

PART 3 EXECUTION

3.1 SELLER’S FIELD TECHNICAL ADVISOR

A. Provide qualified part-time field technical advisor with duties including participation in pre-installation verification, pre-startup verification, startup testing verification, and functional performance testing. Field technical advisor shall have a minimum of five (5) years of demonstrable experience with packaged, induced-draft, crossflow cooling tower equipment and auxiliary systems.

B. Provide documentation of field technical advisor’s qualifications. If at any time Owner deems the field technical advisor unqualified, and upon written request, Seller shall provide a new field technical advisor at no additional cost to the Owner.

C. Seller shall be responsible for all provisions of this Specification, regardless of the presence of the field technical advisor on site.

D. Seller shall provide the following site visits to Project site in Cedar Falls, IA, for the field technical advisor and supporting local service technicians. Trips shall be non-contiguous. Seller shall provide additional trips as required to confirm performance and operation of equipment.

1. Off-load, handling, and setting supervision: One (1) trip with one- (1) day duration.
2. Pre-installation verification: One (1) trip with one- (1) day duration.
3. Pre-startup verification: One (1) trip with one- (1) day duration.
4. Startup testing verification: One (1) trip with one- (1) day duration.
5. Operations and maintenance personnel training: Refer to 3.2 SELLER’S FIELD SERVICES below.
3.2 SELLER’S FIELD SERVICES

A. Inspect jobsite prior to arrival of cooling towers and coordinate with C-01 General Construction Contractor for delivery, storage, and installation.

B. Supervise off-loading, handling, storage, and installation of all cooling towers.

C. Complete installation verification and pre-functional tests following equipment installation, including field-assembled components, piping, valve, electrical connections, instrumentation, and accessories. Installation verification and pre-functional inspection include, but are not limited to, the following:
   1. General installation and external connections.
   2. Condenser water connections and piping.
   3. Overflow and drain connection and piping.
   4. Fan systems, including motor rotation.
   5. Fan drive systems, including speed reducer, drive shaft, bearings, and lubrication systems.
   6. Installation and calibration of instruments.

D. Seller’s field technical advisor shall confirm installation is performed in accordance with Seller’s recommendations and coordinate with C-01 General Construction Contractor and Design Professional for completion of installation verification checklists, pre-functional testing, and functional testing.

E. Assist in placing the cooling tower into successful operation, including balancing flows, fan blade adjustment, and other necessary adjustments to optimize performance of the unit.

F. Supervise operation of cooling towers for run-in period and document performance.

G. Test and adjust all controls and safeties. Seller shall replace or correct all malfunctioning controls, safeties, and equipment at no cost to the Owner.

H. Prepare trip reports documenting the on-site observations and inspections. Reports shall include weather conditions, photos of the installation process, notes about materials, quality, conflicts, and progress with regards to expected schedule.

I. Operations and maintenance personnel training:
   1. Provide two (2) operation demonstrations of four (4) hours each under supervision of Seller’s factory-trained representative.
   2. Factory-trained representative shall train operating personnel in all proper operation and maintenance procedures.
   3. Training shall start after the system is functionally completed but prior to final acceptance testing.
   4. Training shall include both classroom and hands-on instruction.
   5. Topics covered shall include fan operation, control operation, alarms, schematics, wiring and diagrams, meters, indicators, and routine maintenance.

3.3 STARTUP AND FIELD TEST

A. Verify lubrication of rotating parts; verify oil in gear reducer and lubricate as required.

B. Verify fan rotation direction.

C. Verify pitch angle of all fan blades.

D. Complete laser alignment of motor and gearbox. Provide alignment field report documenting the completion of the laser alignment.
E. Confirm existing water treatment systems, including blowdown for proper cooling tower operation, are available and in service.

F. Verify adjustment of water level to normal operating level and confirm balance of condenser water flow between tower inlets. A testing, adjusting, and balancing contractor will provide the water balance services under Contract C-01 – General Construction.

G. Operation tests to demonstrate that the equipment operates without vibration.

H. Owner’s operating personnel will operate all equipment and components during thermal performance test.

I. Cooling Tower Supplier’s field technical advisor shall be present during the thermal performance test.

J. Achieved cooling tower capacity shall be in accordance with CTI Bulletin ATC-105 final performance test.

3.4 PERFORMANCE TESTING

A. Provide a minimum of 14 days’ notice of thermal performance test to Owner.

B. Owner will furnish operating personnel for the thermal performance test.

C. Retain a disinterested CTI-certified third-party testing agency to conduct an on-site thermal performance test in accordance with CTI Bulletin ATC-105. The thermal performance tests shall be conducted on a date mutually agreed upon by the Owner, installing contractor, and Seller based upon the operational needs of the Power Plant and weather conditions. Achieved cooling tower capacity shall be in accordance with CTI Bulletin ATC-105 final performance test.

D. Provide equipment, instruments, and meters necessary to conduct thermal performance test.

E. Third-party testing agency shall furnish test report summarizing the methodology, data acquisition, and test results in accordance with CTI Bulletin ATC-105 requirements.

F. Owner will provide final authorization and approval of thermal performance testing schedule, subject to Power Plant operation and ambient conditions.

G. Owner’s operating personnel will operate all equipment and components during thermal performance test. Seller’s field technical advisor shall be present during the thermal performance test.

H. If the cooling tower fails to perform within the limits of test tolerance, then the Seller shall make such corrections as are appropriate and agreeable to the Owner to compensate for the performance deficiency. After corrections are made, the tower shall be retested at Seller’s expense. Modifications shall not increase fan motor power or elevation head.

I. Seller shall guarantee the cooling tower supplied shall meet the specified noise criteria. Should the Owner suspect deficiency in the acoustic performance, the Owner, at its option, may conduct an on-site acoustic test under the supervision of a qualified, disinterested third party in accordance with CTI ATC-128. If the cooling tower fails to perform within the limits of test tolerance, then the Seller shall pay for the cost of the test and shall make such corrections as are appropriate and agreeable to the Owner to compensate for the deficiency. After corrections are made, the tower shall be retested at cooling tower Seller’s expense.

END OF SECTION
Water Analysis

This sample was analyzed as received, the results being as follows:

Sampling point: Well Water

<table>
<thead>
<tr>
<th>Cations - Metals</th>
<th>Test Method: CW14024</th>
<th>Filtered</th>
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</thead>
<tbody>
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<tr>
<td>Barium (Ba)</td>
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<td>14.6 mg/L</td>
</tr>
<tr>
<td>Strontium (Sr)</td>
<td></td>
<td>0.689 mg/L</td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td></td>
<td>&lt;0.01 mg/L</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td></td>
<td>&lt;0.01 mg/L</td>
</tr>
<tr>
<td><strong>Total Hardness (CaCO₃)</strong></td>
<td></td>
<td>228 mg/L</td>
</tr>
</tbody>
</table>

Authorized by James Brammeier
Senior Chemist
**Water Analysis**

This sample was analyzed as received, the results being as follows:

**Sampling point:** Well Water

### Anions

<table>
<thead>
<tr>
<th>Anion</th>
<th>Test Method: CW15000</th>
<th>Filtered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride (Cl)</td>
<td>CW15000</td>
<td>1.3 mg/L</td>
</tr>
<tr>
<td>Nitrite (NO2)</td>
<td></td>
<td>1.0 mg/L</td>
</tr>
<tr>
<td>Bromide (Br)</td>
<td></td>
<td>&lt;0.20 mg/L</td>
</tr>
<tr>
<td>Nitrate (NO3)</td>
<td></td>
<td>&lt;0.20 mg/L</td>
</tr>
<tr>
<td>Sulfate (SO4)</td>
<td></td>
<td>15 mg/L</td>
</tr>
<tr>
<td>Chloride (CaCO3)</td>
<td></td>
<td>1.9 mg/L</td>
</tr>
<tr>
<td>Nitrate (CaCO3)</td>
<td></td>
<td>&lt;0.16 mg/L</td>
</tr>
<tr>
<td>Sulfate (CaCO3)</td>
<td></td>
<td>15 mg/L</td>
</tr>
</tbody>
</table>

### Alkalinity

<table>
<thead>
<tr>
<th>Alkalinity</th>
<th>Test Method: CW11059</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Alkalinity (CaCO3)</td>
<td></td>
<td>250 mg/L</td>
</tr>
<tr>
<td>Phenolphthalein Alkalinity (CaCO3)</td>
<td></td>
<td>&lt;10 mg/L</td>
</tr>
<tr>
<td>Bicarbonate (CaCO3)</td>
<td></td>
<td>240 mg/L</td>
</tr>
<tr>
<td>Carbonate (CaCO3)</td>
<td></td>
<td>&lt;10 mg/L</td>
</tr>
</tbody>
</table>

### Phosphates

<table>
<thead>
<tr>
<th>Phosphates</th>
<th>Test Method: CW13063</th>
<th>Filtered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ortho Phosphate (PO4)</td>
<td></td>
<td>&lt;0.1 mg/L</td>
</tr>
</tbody>
</table>

### Other Analytes

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Test Method</th>
<th>Filtered</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity at 25°C</td>
<td>CW11063</td>
<td>&lt;0.04 mg/L</td>
<td>440 μS/cm</td>
</tr>
<tr>
<td>Ammonia (NH3)</td>
<td>CW13069</td>
<td>&lt;0.12 mg/L</td>
<td></td>
</tr>
<tr>
<td>Ammonia (CaCO3)</td>
<td>CW13069</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH @ 25°C</td>
<td>CW11059</td>
<td></td>
<td>8.3 pH Units</td>
</tr>
</tbody>
</table>

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**COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV**

*ISO 9001:2008*