MARCH 2025 CONTRACTOR SOLICITATION REQUIREMENTS

Provo City Water Reclamation Facility Phase 1, Electrical Re-feed Packages A-E Utah County, Utah



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CONTRACTOR SOLICITATION REQUIREMENTS

For the PROVO CITY WATER RECLAMATION FACILITY PHASE 1, ELECTRICAL RE-FEED PACKAGES A-E BID NO. PROVOEN202529386

GENERAL

The City of Provo (City) is seeking General and Electrical Contractor services to provide Electrical Construction Re-feed services to their existing Water Reclamation Facility (WRF).

Proposals shall be submitted by interested and qualified contractors (B100 License) that are capable and experienced in the type of work described herein of this Contractor Solicitation and in the Contract Documents for the Project. In addition, all interested contractors shall have sufficient, readily available resources in the form of trained personnel, support services, specialized consultants and financial resources to carry out the work without delay or shortcomings. The Solicitation shall be submitted **NO LATER THAN 2:00 PM, Thursday, March 20, 2025** to:

City of Provo Water Resources 1377 South 350 East Provo, UT 84606

Attn: David Torgersen, PE Office: 801-852-6701 Email: dtorgersen@provo.gov

Each proposer shall submit one (1) hard copy, and an electronic version (PDF Format) of the proposal in accordance with Section V, "Proposal FORMAT".

All questions regarding this RFP should be submitted prior to the deadline for questions.

GENERAL

Provo City owns and operates a 21.0 MGD Water Reclamation Facility located at 1685 S East Bay Blvd. The WRF currently treats approximately 12.5 MGD average daily flow. The WRF is currently undergoing major upgrades to the treatment process. As part of the upgrades, new electrical services have been and are being installed to the new process train, however the existing portions of the plant not part of the upgrade have remained on the original electrical service feed. The City has recently secured funding to upgrade the existing electrical service to be more reliable. The objective of this RFP is to identify and select a contractor the City determines as best qualified in the best interest of the City to perform this work.

The City requests a Contractor's Solicitation Statement (Statement) for construction of the Provo City Water Reclamation Facility Electrical Refeed. The submittal requirements for the Statement and the evaluation criteria are included.

PURPOSE

The purpose of the solicitation process is to select a contractor the City deems to be qualified and capable of completing the Project in conformance with the Contract Documents

The Contractors shall not accept quotes, proposals, or sub-bids from any subcontractors, suppliers, or manufacturers that are not qualified to provide the service or supplies proposed. The Contractor is required to comply with all requirements of the Contract Documents and the Instructions to Bidders. Contractor shall identify all proposed subcontractors and define the portion of the Work they will perform.

Selection as the Contractor does not imply Owner's acceptance or approval of the Contractor's specific personnel, suppliers, manufacturers, equipment or methods, whether or not these items are described in the Contractor's Statement. It shall be the responsibility of the selected Contractor to perform the project in accordance with the standards set forth in the contract documents and industry standards.

PROJECT DESCRIPTION

The Provo City Water Reclamation Facility Phase 1, Electrical Refeed Packages A-E is being constructed to update electrical feeds to all existing WRF processes and load centers to make them more reliable and secure, and to get the existing plant off of the old and outdated electrical components.

Construction of the Provo City Water Reclamation Facility Electrical Refeed is divided into five (5) separate packages, and generally includes installation of electrical wiring, components, transformers and other improvements identified in the Contract Documents, and described briefly as follows:

- Package A:
 - Demolition and Replacement the Primary Sludge Pump Station No. 2 MCC "C".
 - Installation of feeds from Power Distribution Building Load Center PB-CLC-001 to New Primary Sludge Pump Station No. 2 MCC-C.
 - Installation of HVAC equipment at Primary Sludge Pump Station No. 2 to meet the requirements of NFPA-820 for that facility.
- Package B:
 - Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 1 (EIP-3).
 - Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001to Load Center No. 1 (EIP-3).
 - Replacement and installation of a new low-profile pad mounted switchgear and 500KVA pad mounted transformer.

- Package C:
 - Installation of new electrical feed from Pad-Mounted Switchgear SE-NSX-001A to Headworks Building Automatic Transfer Switch via H-MCB-001A
- Package D:
 - Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 4 located at the Chlorine Building.
 - Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001 to Load Center No. 4 located at the Chlorine Building.
- Package E:
 - Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 2 and No. 3 located at the Existing Blower Building.
 - Installation of new electrical feed from Pad-Mounted Switchgear SE-NSG-001A to Load Center No. 2 located at the Existing Blower Building.

FAMILIARITY WITH PROJECT

The solicitation information packet is available for review by interested contractors on the state procurement website at: **https://purchasing.utah.gov/currentbids**. No pre-bid conference or site visit is planned for Contractors.

Contractor may submit questions to clarify the solicitation requirements and bid documents via the project solicitation portal on sciquest.com. Questions shall be submitted no later than the schedule defined in the contract documents.

SUBMITTAL PROCEDURE

Statements will be received at the following address, until 2:00 pm, Thursday, March 20, 2025:

Provo City Public Works Attn: David Torgersen, P.E. 1377 South 350 East Provo, UT 84606

Provide one hard copy and one electronic file copy (in pdf format on flash drive) of the requested information. Mark envelope or container with "Solicitation for Provo City Water Reclamation Facility Phase 1, Electrical Refeed Packages A-E", name of contractor, and company address. State submission deadline date and time.

Any statement failing to clearly present all the requested information or failing to be in the requested format may be considered nonresponsive and rejected.

Information contained in the Statement will be considered confidential and reasonable precautions will be taken to protect the security of the documents. The Statement will become and remain the property of the City.

The City reserves the right to request a contractor to clarify any part of his Statement. Response to such requests must be made in writing and will become part of the Statement. Unsolicited supplementary information and materials received after the deadline will not be considered in the evaluation.

TENTATIVE SCHEDULE – PROVO CITY SOUTHWEST LIFT STATION FORCE MAIN BID NO. PROVOEN202319466

The following is a preliminary schedule for the Provo City Water Reclamation Facility Phase 1, Electrical Refeed Packages A-E and is subject to change:

CONTENT OF STATEMENT

The Statement shall include the information requested below. The organization of the Statement shall generally follow the outline below and be limited to a maximum of 15 single sided pages (Title Page and Construction Bid Documents excluded):

- 1. Title page
- 2. Previous Project Experience and References
- 3. Personnel and Qualifications
- 4. Construction Methodology for Project
- 5. Construction Schedule with Proposed Project Final Completion Date
- 6. Financial Information
- 7. Safety Program
- 8. Construction Bid (In a separate sealed envelope)

EVALUATION OF STATEMENTS

Statements will be assessed using the following point-based criteria:

Criteria	Max Points
Previous Project Experience	20 points
Personnel/Project Manager/Project Engineer/Superintendent	20 points
Construction Methodology and Sequencing for Project	20 points
Construction Schedule	20 points
Construction Cost	20 points

<u>Title Page</u>

The title page shall identify the document as a Bid Statement and shall include the name of the Owner, the name of the Project and the name of the contractor.

Previous Project Experience (20 points)

Project experience information that presents the requested information.

- 1. Describe past experience showing satisfactory completion or progress on work of similar complexity and comparable in scope to that described herein. Demonstrate ten years of recent experience in water/wastewater utility construction projects.
- Provide the following information: Project name, contract award and completion dates, Owner's name with contact and phone number, bid and final amounts, number and cost of change orders, prime contractor/subcontractor status and approximate amount of involvement.
- 3. List any work awarded within the past ten years but not completed and the reasons for not completing the work.

Personnel/Project Manager/Project Engineer/Superintendent (20 Points)

Provide names and brief resumes for the proposed project team, specifically for the individuals outlined below as applicable:

- Project Manager
- Alternate Project Manager
- Project Engineer
- Superintendent(s)

The proposed project manager assigned to the project should demonstrate at least **ten (10) years** of experience in the construction of water/wastewater electrical facility improvements. Submit the name and brief resume of the project manager who will be assigned to the project. The resume should provide an experience summary including the following: the name of each project, description of project, position held, employer, responsibilities, and a reference and phone number of all construction assignments in the last **five years**. Submit the name, resume, and experience summary of an alternate project manager who will be assigned to the project in the event the proposed project manager becomes unavailable for this assignment. The alternate project manager must satisfy the above experience requirements. Submit similar information on the project team (min. 5 years' experience). These individuals will be evaluated on the basis of technical experience, managerial experience, and education.

Construction Methodology and Sequencing for Project (20 Points)

Submit a thorough discussion of construction methodology and sequencing to accomplish a preferred Substantial Completion date within 10 to 12 months of Notice to Proceed. If subcontractors are proposed for any portion of the work, provide the name of the

subcontractor, contact information, and the portion of the work they will perform. The City may request follow-up information on subcontractor qualifications if deemed pertinent to the award of the project.

Construction Schedule (20 Points)

Submit a preliminary construction schedule identifying the critical path activities and demonstrating how the work will be accomplished to meet the required Contract Times.

Qualified contractors must meet the following minimum criteria:

- Contractor shall hold a current contractor's license in the State of Utah in the classification appropriate to this Project. (B100)
- Contractor shall have \$5 million available bonding capacity.
- Contractor shall meet all General Conditions of the Contract Requirements

Meeting the minimum criteria above does not automatically qualify the Contractor. The Owner will evaluate all proposals and reserves the right to select the most qualified Contractors. The Owner shall be entitled to contact each and every reference listed by the contractor. The contractor, by submitting a Statement, expressly agrees that any information concerning the contractor in possession of said entities and references may be made available to the Owner.

The Contractor whose solicitation is deemed most advantageous to the City, at its sole discretion, will be selected for contract negotiation. The City is under no obligation to select a contractor from the proposers who choose to respond to the RFP. The City may, in its sole discretion:

- Reject any Proposal
- Determine which Proposers are responsible and qualified to provide the subject services
- Conduct additional interviews with representatives of one or more Proposers
- Request additional information to support the Proposal
- Request clarifications/additional information during the evaluation process
- Contact references provided by the Proposer and such other references as the City may determine appropriate
- Enter into a final agreement with a Proposer with terms that may vary from those contained in the RFQ or the SOQ
- Evaluate Proposals based upon the best interests of the City, including but not limited to, the evaluation criteria contained in this RFP
- Accept other than the lowest cost Proposal based upon an evaluation of other aspects of the Proposal
- Waive minor informalities, technical inconsistencies or irregularities in

any Proposal

• Delete any item/requirement from this RFP when deemed to be in City's best interest

All Proposals become the property of the City and will not be returned.

Neither the City of Provo, it's City Council, officers, employees, agents, representatives, nor any of its consultants will be liable for any claim or damages resulting from the RFP process.

This RFP does not obligate the City of Provo to pay any costs incurred by a Proposer or other interested party for any activity involved in the preparation and submission of Proposals or any other aspect of this RFP process or negotiation of a contract.

By submitting a Proposal in response to this RFP, the Proposer accepts the evaluation process and acknowledges and accepts that determination will require subjective judgments by the City. All information, documentation, and other materials submitted in response to this solicitation are considered non-confidential and/or non-proprietary and are subject to public disclosure after the solicitation is completed.

The City doesn't anticipate, but may at its discretion, establish a list of finalists based on the Evaluation Criteria outlined above. The finalists may be invited to an interview per the tentative schedule to clarify Proposals and qualifications. The proposed Project Manager and key staff shall be present at the interview. Award of an agreement is subject to approval by the City administrative staff.

NOTIFICATION OF CONTRACTORS

All contractors submitting Statements will be notified in writing.

The Owner's decision will be final.

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NOTICE INVITING BIDS

PROVO CITY CORPORATION will receive sealed solicitations and bids for Construction of the Provo City Water Reclamation Facility, Phase 1 Electrical Refeed Packages A-E, Bid No. PROVOEN202529386. Bids will be received until 2:00 p.m. March 20, 2025 at the Provo City Engineering Office, 1377 South 350 East, Provo, Utah 84606.

WORK PRIMARILY CONSISTS OF: Refeeding existing facilities and load centers from the Water Reclamation Facility's new Power Distribution Building to replace obsolete equipment and to promote process reliability and plant safety.

COMPLETION OF WORK: CONTRACTOR to advise City in its proposal of its proposed substantial completion date. WORK must be completed as efficiently as possible with a preferred project completion date within 10 to 12 months of Notice to Proceed.

OBTAINING CONTRACT DOCUMENTS: Contract documents, including drawings and technical specifications, may be obtained online at Sciquest (www.purchasing.utah.gov/currentbids) or Water Works Engineers beginning February 27, 2025 at 2975 Executive Parkway, Suite 310, Lehi, UT 84043. The cost of the contract documents, when obtained from Water Works Engineers, is \$100.00 and is non-refundable.

NOTICE OF PUBLICATION: Posted on Sciquest beginning February 27, 2025 through March 20, 2025.

PROJECT INFORMATION: Information on the Provo City Water Reclamation Facility, Phase 1 Electrical Refeed Packages A-E may be requested from Jenny Calderon, Project Manager, (385) 288-1465.

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DOCUMENTS FOR THE CONSTRUCTION OF



PROVO CITY CORPORATION

WATER RECLAMATION FACILITY

PHASE 1 ELECTRICAL REFEED PACKAGES A-E

VOLUME 1 - SPECIFICATIONS

FEBRUARY 2025

100% SUBMITTAL



ENGINEERS:



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DOCUMENT 00 01 01 TITLE PAGE

	CONSTRUCTION OF	
Pr Ph:	ovo City Water Reclamation Facility ase 1, Electrical Re-feed Packages A-E	
	BID NO. PROVOEN202529386	
	CONTRACT DOCUMENTS	

City of Provo Water Resources Water Reclamation Facility Phase 1, Electrical Refeed Packages A-E David Torgersen, P.E. – Principal Engineer 1377 South 350 East Provo, Utah 84606 (801) 852-6740

Bids will be received and deposited at the office of the Provo City Public Works Building, located at the above address, until 2:00 PM on Wednesday, March 20, 2025.

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- 00 39 12 Notice of Intent to Award
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- 00 43 00 Bid Schedule
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DOCUMENT 00 11 16 INVITATION TO BID

PART 1 GENERAL

1.1 CONSTRUCTION CONTRACT

- A. Bidders are invited to bid on the Construction Contract known as Provo City Water Reclamation Facility, Phase 1, Electrical Refeed Packages A-E.
- B. The location of the work is: Provo City Water Reclamation Facility, 1685 South East Bay Blvd. Provo, Utah 84606
- C. The Work generally includes, but is not limited to, the following: Removing feeds from the plant's Power Distribution Center to existing facilities and load centers throughout the Water Reclamation Facility site and refeeding those facilities from the new Power Distribution Building.
- D. For information about the Construction Contract, contact Jenny Calderon, PE, Project Manager at Water Works Engineers (385) 288-1465.

1.2 BID LOCATION AND OPENING

- A. Sealed solicitations and bids will be received until 2:00 p.m., Monday, March 20, 2025 at the Provo City Public Works Building, 1377 South 350 East, Provo, Utah 84606. Bids received after 2:00 p.m., as conclusively established by the clock at the Bid opening location, will not be accepted.
- B. On the outside of the envelope, the bidder shall indicate the Construction Contract title, the name and address of the Bidder, and the date and time of Bid opening and the Bidder's return mailing address.

1.3 BID BONDS

A. A Bid Bond in the amount of 5 percent of the Bid must accompany each Bid in accordance with the Instructions to Bidders. The Bid Bond will be returned to each unsuccessful Bidder after tabulation and award of the Construction Contract.

1.4 BASIS OF BIDS

A. Bids shall be on a lump sum basis. Unsealed or segregated Bids will not be accepted.

1.5 CONTRACT TIME

A. Contractor to provide a Construction Schedule with a Proposed Contact Completion Date. It is preferred that the Work will be Substantially Complete within 10 to 12 months of Notice to Proceed.

> Invitation to Bid 00 11 16 - 1

1.6 EXAMINATION AND PROCUREMENT OF DOCUMENTS

A. Complete sets of Contract Documents may be examined and obtained online at SciQuest (<u>www.purchasing.utah.gov/currentbids</u>) or from Water Works Engineers at 2975 South Executive Parkway, Suite 310, Lehi, UT 84043 until March 20, 2025. The cost of the contract documents, when obtained from Water Works Engineers, is \$100.00 and is non-refundable.

1.7 **RIGHT TO REJECT BIDS**

A. Provo City reserves the right to reject any or all bids or to waive any informality or technicality in any bid if deemed to be in the best interest of Provo City.

1.8 GOVERNING LAWS AND REGULATIONS

- A. This project is not federally funded and does not require the payment of specific wage rates. Payroll submittal will not be required.
- B. Bidders on this Work will be subject to the applicable provisions of all federal rules, laws and regulations or orders.
- C. Bidder must provide proof that he has completed the registration process in an approved immigration status verification system and is in full compliance with the immigration status verification program as well as all requirements of Utah Code Section 63G-12-302.
- D. Bidder will also be required to provide similar proof of compliance for any subcontractor who works under the terms of the Contract Documents.

END OF DOCUMENT

DOCUMENT 00 21 13 INSTRUCTIONS TO BIDDERS

PART 1 GENERAL

1.1 **DEFINED TERMS**

- A. Terms used in the Bid Documents that are defined in Article 1.1 of the General Conditions will have the meanings indicated in the General Conditions.
- B. General Conditions: as published in Document 00 72 00 in the <u>Manual of Standard</u> <u>Specifications</u> by the Utah Chapter of the American Public Works Association.

1.2 COPIES OF BID DOCUMENTS

- A. Bidders must use complete sets of Bid Documents in preparing Bids. OWNER and ENGINEER assume no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- B. Bid Documents are made available to bidders only for the purpose of obtaining Bids on the Work. No license or grant for any other use is given.
- C. Bidding Document copyrights shall remain with the OWNER.
- D. All provisions of the current edition of the <u>2017 Manual of Standard Specifications</u> and <u>Manual of Standard Plans</u> published by the Utah Chapter of the American Public Works Association that are applicable to the Work are hereby made a part of the Contract Documents by reference and can be downloaded separately from Utah APWA's website.

1.3 PRE-BID COMMUNICATION

A. The OWNER shall not be bound by any statements, representations, conclusions, or assumptions made by any party, whether oral or written, except for written statements that are issued in an Addendum by the ENGINEER to all prospective bidders.

1.4 PHYSICAL CONDITIONS

- A. In General: Prior to submitting a Bid, each Bidder is responsible to review all available explorations, tests and data concerning surface conditions, subsurface conditions and Underground Facilities at or contiguous to the site, or otherwise, which may affect cost, progress, performance or furnishing of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.
- B. Underground Facilities: Information and data indicated in the Contract Documents regarding Underground Facilities at or contiguous to the site is based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities. The OWNER does not assume responsibility for the accuracy or completeness thereof other than as provided in paragraph 4.3A.2 of the General

Conditions or unless expressly provided in the Modifications to General Conditions (Document 00 73 03).

C. Additional Explorations and Tests: If feasible as determined by OWNER, the OWNER will provide each Bidder access to the site to conduct any explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall obtain permits, fill all holes, clean up and restore the site to its former condition upon completion of such explorations. by requesting such an exploration or test, Bidder agrees to release, indemnify, defend, and save the OWNER harmless from all costs damages and liabilities an any kind whatsoever, including reasonable attorneys' fees, that may arise in connection with or as a result of the performance of such explorations or tests.

1.5 COMPENSATION AND QUANTITIES

- A. In General: The bid price for any lump sum or unit price contract includes all labor, materials, and incidental work to fully complete the Work in a satisfactory manner under the terms of the Contract Documents. Bidders are responsible to inform themselves of the character of the Work to be performed.
- B. Lump Sum Work: If the Work is to be paid for on a lump sum basis, the lump sum will be the only sum paid.
- C. Unit Price Work: If any portion of the Work is to be paid for on a unit price basis, payment will cover only work actually performed and materials actually supplied at the unit prices bid and on the terms set forth in the Contract Documents, irrespective of any quantity approximations in the Bid Documents. Any quantity approximations in the Bid Documents are stated as a basis for determining bids, and do not fix the amount of Work to be done or materials to be furnished. Stated quantities are estimates for the purpose of doing the class of work required. Actual quantities will vary. The OWNER may deviate in either direction from any indicated quantities. The Bidder shall have no claim for any variation in quantity, except to the extent permitted in the General Conditions.

1.6 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

- A. In General: The OWNER shall not be bound by any statements, representations, conclusions, or assumptions made by any party, whether oral or written, except for written statements that are issued in an Addendum.
- B. Access: The Contract Documents designate the site for performance of the Work. Bidder is responsible to investigate the site and understand all access requirements. All additional off site lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Bidder.
- C. **Contract Documents**: The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 1.4; that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents; and that the Contract Documents are

sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

- D. **Bidder's Obligations**: In addition to Bidder's other responsibilities and obligations in connection with submitting a Bid, it is the responsibility of the Bidder before submitting a Bid, to:
 - 1. Examine the Contract Documents thoroughly;
 - 2. Visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work;
 - 3. Investigate all applicable construction and labor conditions, quantities, and the character of the Work as they affect cost, progress, performance, or furnishing of the Work;
 - 4. Consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work;
 - 5. Study and carefully correlate Bidder's observations with the Contract Documents;
 - 6. Review all available explorations and data concerning surface and subsurface conditions as set forth in Section 1.4 above; and
 - 7. Identify and notify ENGINEER in writing in the manner set forth in article 2.1 below of all specific conflicts, omissions, errors, or discrepancies in the Contract Documents, or if Bidder doubts their meanings.

The failure or omission of any Bidder to take any of the foregoing actions shall not in any way relieve Bidder of its Bid, or its obligation to furnish all material, equipment, labor and services necessary to carry out the provisions of the Contract Documents and to complete the contemplated Work for the consideration set forth in its Bid. Submission of a Bid shall constitute prima facie evidence of compliance with these instructions.

E. **Deviations from the Terms of the Contract Documents**: OWNER will not accept any deviations whatsoever from the printed terms of the Agreement and the Contract Documents, except by Addendum or Change Order.

1.7 EFFECT OF SUBMITTING BID.

- A. Bidders are responsible to carefully examine the Contract Documents, visit the site, and fully inform themselves so as to include in the Bid a sum to cover the cost of all items. Bidder's failure or omission to receive or examine any form, instrument, addendum or other document, visit the site and become acquainted with existing conditions, or attend any pre-Bid Conference, shall in no way relieve Bidder from any obligations with respect to Bidder's Bid or the Construction Contract.
- B. By submitting a Bid, Bidder represents that Bidder has complied with all requirements of the Bid Documents; that the Bid is premised on properly performing and furnishing the Work required by the Contract Documents within the times specified; that the Bidder is informed of the conditions to be encountered and the character, quality and quantities of the Work; and that the Bidder believes the Contract Documents are

sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

- C. Submission of a Bid constitutes a promise that the Bidder will enter the Contract Documents in the form presented in the Contract Documents. Bidders should carefully examine all Contract Documents, including the required Bonds and insurance to be provided by the Bidder.
 - 1. The Performance Bond is a guarantee of faithful performance of the requirements of the Contract Documents, including all applicable warranties. The Payment Bond is a guarantee of payment of all labor, materials, or supplies used directly or indirectly in the prosecution of the Work provided in the Construction Documents.
 - 2. The sum of the Performance Bond and the Payment Bond shall be increased or decreased during the course of the Work in the event that Contract Modifications, Change Orders or Addenda increase or decrease the total contract price. The sum of each bond shall be in an amount equal to the completed contract price at the completion of the Work.
 - 3. OWNER does not provide any release of Performance Bonds or Payment Bonds. The bonds are in effect throughout all periods during which a suit may be brought under the provisions of applicable law.
- D. By submitting a Bid, Bidder represents that the matters stated therein are true and correct.

PART 2 BIDDING PROCEDURES

2.1 INTERPRETATIONS AND ADDENDA

- A. All requests for interpretation of the Contract Documents shall be made in writing and delivered to the ENGINEER no later than seven (7) calendar days prior to opening of Bids. In the ENGINEER's discretion, ENGINEER will send the written interpretation to all persons receiving a set of Bid Documents in the form of an Addendum. If the ENGINEER does not respond to a Bidder's request for interpretation the Bidder shall comply with the intent and terms of the Contract Documents.
- B. No oral interpretations shall be made to any Bidder. The OWNER shall not be responsible for or bound by any statements, interpretations, explanations, representations, conclusions or assumptions made by any party, whether oral or written, except for written statements that are issued in an Addendum by the ENGINEER to all prospective bidders.
- C. Each statement made in an Addendum is part of the Contract Documents at the location designated in the Addendum. A statement issued in an Addendum shall have the effect of modifying a portion of the Bid Documents when the statement in the Addendum specifies a particular section, paragraph or text and states that it is to be so modified. Only the specified section, paragraph or text shall be so modified, and all other portions of the Bid Documents shall remain if effect.

- D. Bidders shall sign to acknowledge their receipt of all Addenda issued. Bidders shall also acknowledge receipt of all Addenda in the space provided in the Bid.
- E. Except to postpone the Bid opening, no Addenda shall be issued within 48 hours of the Bid opening.

2.2 EQUIPMENT AND MATERIAL OPTIONS PRIOR TO BID OPENING

- A. If a Bidder or Supplier wishes to supply a product other than that identified in the Contract Documents, said Bidder or Supplier shall submit a written request for approval to the ENGINEER at least ten (10) calendar days prior to the date set for opening of bids.
- B. The procedure for submission of any such product option shall be as set forth in Article 6.4 of the General Conditions. It is the sole responsibility of the Bidder or Supplier to submit complete descriptive and technical information so that ENGINEER can make a proper appraisal.
- C. ENGINEER's failure to act upon such a request within five (5) days after receipt shall be deemed a denial thereof.
- D. Any such approval is at the sole discretion of the ENGINEER and will be in the form of an Addendum issued to all Bidder's holding Bid Documents indicating that the additional equipment or materials are approved as equal to those specified for the Project.
- E. The Construction Contract, if awarded, will be on the basis of materials and equipment specified in the Drawings and Specifications and any changes permitted in any Addenda.

2.3 BID SECURITIES

- A. Amount of Bid Security: A Bid Security must accompany each Bid. The total amount of the Bid on which Bid security is to be based shall be the sum of all items of the Bid constituting the maximum amount of the possible award to the Bidder. The Bid Bond amount must equal at least five (5) percent of the total amount of the Bid.
- B. Form of Bid Security: The Bid Security may be in the form of a certified check, cashier's check, cash, or Bid Bond. No other form of Bid Security will be accepted. A Bid Bond must be issued by a licensed Utah agency on behalf of a surety company licensed to do business in the State of Utah. A cashier's check must be drawn on a bank doing business in the State of Utah and made payable to OWNER. If a cashier's check is used in lieu of a Bid Bond, or if the Bid Bond does not specifically so provide, a certificate from an approved surety company guaranteeing execution of performance and payment bonds in the full amount of the bid must accompany the bid.
- C. **Purpose of Submission**: By submitting a Bid Bond Bidder assures OWNER it will take all steps necessary to properly execute the Contract Documents.
- D. **Return of Bid Security**: OWNER will return Bid securities to Bidder within 7 days after award of the Construction Contract. Bid Bonds and cashier's checks of all Bidders will be held until the Construction Contract is awarded or all bids have been rejected.

The liability of OWNER in regards to the checks shall be limited only to the return of the checks.

E. **Default**: In the event of failure or refusal of the Bidder to enter into the Construction Contract and the delivery to the OWNER a Performance Bond, Payment Bond and any other Bonds or documents required by the Contract Documents after Notice of Intent to Award by the OWNER, the Bidder forfeits the sum of the Bid Bond or cashier's check as liquidated damages to the OWNER.

2.4 COMPLETING BID DOCUMENTS

- A. The General Conditions identify all forms comprising the Bid Documents. Additional copies may be obtained from the ENGINEER. The Bidder shall make no stipulations or alterations on the Bid forms. The Bidder must use and execute only the Bid form and Bid Schedules bound in the Contract Documents. The complete Contract Documents (excluding the Drawings) should be submitted as the Bidder's Bid, and Bidder shall complete and submit all forms included in the Bid Form, Document No. 00 41 00.
- B. The Bidder must fill in all items in the Bid form in ink or by typewriter. If applicable, furnish both the unit and total costs for each item. The total Bid price is the full price for the performance of all Work under the Contract Documents. Bidder shall initial in ink any corrections, interlineations, alterations, or erasures made by the Bidder on Bidder's entries in the Bid Documents.
- C. Any work or material which is specified in the Contract Documents or which is necessary because of the nature of the Work, but which is not listed separately in the Bid Schedule shall not be measured or paid for separately. The cost of such work or material shall be considered as included in the Contract Price.
- D. Bids by corporations must be executed in the corporate name by a corporate officer authorized to sign, and must be properly attested to as an official act of the corporation. At the OWNER's request, authority to sign shall be submitted.
- E. Bids by partnerships or joint ventures must be executed in the partnership or joint venture name and signed by a partner or joint venture whose title and official address must be shown. If a partnership or joint venture is the low bidder, the partnership or joint venture must also submit evidence to the OWNER of the responsibility of the partnership or joint venture as a bidder in the manner directed by the ENGINEER.
- F. Where the Bidder is wholly owned subsidiary of another company, the Bid must so state, and the owner or parent corporation also must agree to sign and be bound with the Bidder.
- G. All names must be typed or printed under or near the signature. Signatures shall be in longhand.
- H. The Bid shall contain an acknowledgment of receipt of all Addenda. The Addenda numbers must be filled in on the Bid form.
- I. The Bidder's address, telephone number, and facsimile number for communications regarding the Bid must be shown on the first page of the Bid form.

- J. The divisions and sections of the specifications, and the identifications of any Drawings, shall not control Bidder in dividing the Work among subcontractors or suppliers, or delineating the Work to be performed by any specific trade.
- K. The base Bid and alternates shall include all Work required to be performed by the Contract Documents.
- L. The Government Records Access and Management Act ("GRAMA"), Utah Code Section 63G-2-101 et seq., cf. Provo City Code Section 3.13.010 et seq., states that certain information in the submitted Proposal may be open for public inspection. If the Firm desires to have information contained in its proposal protected from such disclosure, the Firm may request such treatment by providing a "written claim of business confidentiality and a concise statement of reasons supporting the claim of business confidentiality" with the Proposal (Provo City Code Section 3.13.308). All material contained in and/or submitted with the Proposal becomes the property of Provo City and may be returned only at Owner's option.

2.5 CONFLICT OF INTEREST, SUBCONTRACTORS

- A. Conflict of interest pertaining to Subcontractors is described in paragraph 6.5H of the General Conditions (Document 00 72 00).
- B. Bidder shall not subcontract more than 75 percent of the dollar value of the total contemplated Work (exclusive of the supply of materials and equipment to be incorporated in the Work) without OWNER's prior written approval.

2.6 SUBMISSION OF BIDS

- A. Bids shall be submitted at the time and place indicated in the Invitation to Bid and should be enclosed in an opaque sealed envelope, marked with the Construction Contract name and number, the name and address of the Bidder, and the date and the opening time for Bids. If the Bid is sent through the mail or other delivery system the sealed envelope should be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. It is the sole responsibility of the Bidder to deliver the Bid before the scheduled time.
- B. Bidder will make no recapitulations, stipulations, alterations, alternate submissions, or modifications in any manner to any of the Contract Documents.
- C. All bidders shall include the following documents with bid including required signatures and notary verification where designated:
 - 1. Bid Form (Document 00 41 00)
 - 2. Bid Bond (Document 00 42 00)
 - 3. Bid Schedule (Document 00 43 00)
 - 4. Proposed Subcontractor Form (Document 00 43 36)
 - 5. Bidder Status Form (00 43 38)
 - 6. Status Verification System Affidavit (Document 00 45 37)

- 7. Non-Collusion Affidavit of Prime Bidder (Document 00 45 38)
- 8. Performance Bond (Document 00 61 13)
- 9. Payment Bond (Document 00 61 14)
- 10. Certificate of Insurance (Document 00 62 16)
- 11. E-Verify Memorandum of Understanding

Failure to include any of these documents will result in Bid being considered non-responsive and may be disqualified.

- D. Construction bid and solicitation shall be submitted in separately sealed envelopes.
- E. Alternate bids, other than those called for in the Bid form, will not be considered.
- F. No oral, telegraphic, telephonic, facsimile or modified bids will be considered.

2.7 MODIFICATION AND WITHDRAWAL OF BIDS

- A. At any time prior to the opening of Bids, Bids may be modified or withdrawn if a written notice of modification or withdrawal is signed by Bidder and delivered to the place where Bids are to be submitted. Bid Security will be returned upon proper withdrawal of a Bid prior to the time for Bid opening.
- B. Within 24 hours after Bids are opened, any Bidder may file written notice with OWNER that there was a substantial mistake made in the preparation of its Bid. Bidder must thereafter promptly demonstrate Bidder's mistake. The OWNER has sole discretion to determine whether to permit any modification or withdrawal or the return of any Bid Security.
- C. When it appears a mistake has been made, or when the OWNER desires an assurance of any matter, the OWNER may request a Bidder to confirm the Bid in writing.

2.8 **OPENING OF BIDS**

- A. An abstract of the amounts of the base schedule of prices and any alternate schedules will be made available for review after the opening of Bids.
- B. Any Bids received after the time specified in the Invitation to Bid will be returned unopened.

2.9 BIDS SUBJECT TO ACCEPTANCE FOR 45 DAYS

A. All bids remain subject to acceptance for 45 days after the day of the Bid opening. OWNER may, in its sole discretion, release any Bid and return the Bid security prior to that date.

PART 3 EVALUATION AND AWARD

3.1 SUBMITTALS REQUIRED FOR EVALUATION

- A. After Bid opening, the Bidder, whose Bid is under consideration, must submit the following at the times specified:
 - 1. **Bidder Status Form**: Document 00 43 38. The Bidder shall submit this report form within 24 hours of ENGINEER's request.
 - 2. **Proposed Subcontractor Form**: Document 00 43 36. The Bidder shall submit this report form within 24 hours of ENGINEER's request.

3.2 EVALUATION OF BIDDER'S QUALIFICATIONS

- A. Within seven (7) calendar days of ENGINEER's request, a Bidder, whose Bid is under consideration for award shall submit to the ENGINEER the following information for the Bidder. ENGINEER may request like information on Bidder's Subcontractors, Bidder's Suppliers or any other information the ENGINEER may require.
 - 1. A current financial statement for the Work (as provided to bonding company);
 - 2. A chronological list of "in progress" and "completed" construction work done by Bidder during the last 3 years; including project name, address, owner, contract name, and current telephone number;
 - 3. Present construction commitments other than items listed in paragraph 2 above;
 - 4. Proposed organizational structure such as firm ownership, project manager, progress scheduler, and superintendent for the Work of this Project;
 - 5. Owned and rented equipment which is to be used to do the Work;
 - 6. Investigations, arbitration, litigation or claims which are pending, threatened, settled or otherwise disposed of within the last three (3) years;
 - 7. Evidence of ability to perform and complete the Work in a manner and within the time limit specified. As a minimum, identify specific experience on projects similar to the Work in physical size, cost, and commercial nature. If the work experiences of the project manager and superintendent designated to construct this project are different than that of the company, provide resumes of their work history. Include their actual project titles and indicate their actual responsibilities on each given project;
 - 8. All matters consistent with federal, state and local Laws and Regulations; and
 - 9. Such other data as may be called by the ENGINEER.
- B. If Bidder believes any information should be held confidential for business reasons, Bidder must submit a written claim of business confidentiality for that particular information and include a specific statement of the reasons supporting the claim pursuant to Utah Code Ann. § 63-2-308.

C. Untimely response or failure to provide the requested information by Bidder will release OWNER of any obligation to further consider the Bidder's Bid.

3.3 EVALUATION OF BIDS

- A. OWNER reserves the right: to reject any and all Bids or any part thereof; to waive any informalities in the Bid Schedule and elsewhere; to negotiate and agree to contract terms with the successful Bidder; to disregard non-conforming, non-responsive, unbalanced or conditional Bids; and to withhold the award for any reason deemed in the best interests of the OWNER.
- B. OWNER reserves the right to reject any Bid if OWNER believes that it would not be in the best interest of the Project or the OWNER. Without limitation, such rejection may be because the Bid is not responsive, or the Bidder is unqualified or of doubtful ability or the Bid or Bidder fails to meet any other pertinent standard or criteria established by OWNER.
- C. If the OWNER intends to make an award to a Bidder, a Notice of Intent to Award will be issued.
- D. OWNER may consider all information which OWNER believes is relevant when evaluating a Bid, including, without limitation:
 - 1. The qualifications and experience of the Bidder and of the Subcontractors, Suppliers, and other persons and organizations proposed (whether or not the Bid otherwise complies with the prescribed requirements).
 - 2. Such alternates, unit prices and other data, as may be requested in the Bid Form, Bid Schedule, or written requests issued prior to OWNER's Notice of Intent to Award the Construction Contract.
 - 3. Operating costs, maintenance requirements, performance data, and guarantees of ability to provide the required materials and equipment.
 - 4. Corporate organization and capacity for any party.
 - 5. Ability to perform and complete the Work in the manner and within the time specified.
 - 6. Pending litigation.
 - 7. The amount of the Bid.
 - 8. Proper licensing to do the Work in compliance with licensing laws of the State of Utah for contractors and subcontractors.
 - 9. All other relevant matters, consistent with OWNER's procurement code and administrative rules, OWNER's ordinances and program policies.
- E. To establish qualifications of Bidder, OWNER may request such data indicated in the Bid Documents, conduct such investigations as OWNER deems appropriate, and consider any other information (whether obtained from the Bid, the Bidder, or any other source).

- F. If the Construction Contract is to be awarded, it will be awarded to the most responsive, qualified, and responsible Bidder as determined by the OWNER. Alternates may be accepted depending upon availability of OWNER's funds and as determined by the OWNER. Accepted alternates will be considered in determining the most responsive, qualified, and responsible Bidder.
- G. Bid Schedules will be evaluated as follows:
 - 1. Discrepancies in the multiplication of quantities of Work items and unit prices will be resolved in favor of the unit prices. OWNER may correct Bid Schedule calculation errors accordingly.
 - 2. Prices written out in words shall govern over prices written out in numbers.
 - 3. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.
 - 4. Bids shall not contain any recapitulations of or changes in the work to be done.
- H. The OWNER, in the OWNER's sole discretion, shall make determinations as to disqualification of Bidders or rejection of Bids. Such matters may include, without limitation, submission of more than one Bid by the Bidder (whether under the same or different names); evidence of collusion among Bidders; other commitments of Bidder which, in the OWNER's sole judgment, might hinder the Work; previous defaults, Bid irregularities when not waived in the best interests of the OWNER, delays or poor performance by Bidder on any project; official action against Bidder; and any other cause which, in the OWNER's sole discretion and judgment, is sufficient to justify disqualification of a Bidder or rejection of a Bid.

3.4 ADJUSTMENTS TO THE COST OF THE WORK AFTER OPENING OF BIDS

- A. The Contract Price identified in the Agreement represents the cost of the work which is to be paid by the OWNER to the CONTRACTOR.
- B. Adjustments to the Contract Price which are agreed to between the OWNER and the successful Bidder shall be effected by signing an Agreement Supplement.

3.5 SUBSTITUTIONS

- A. The Construction Contract, if awarded, will be on the basis of materials and equipment described in the Drawings, Specifications and any Addenda.
- B. After the Effective Date of the Construction Contract, the procedure for submitting an application for substitution is set forth in Article 6.4 of the General Conditions.

3.6 SUBMITTALS REQUIRED FOR AWARD OF CONTRACT

In order to execute the contract, the following documents shall be submitted to OWNER within ten (10) calendar days of the receipt of the NOTICE OF INTENT TO AWARD.

- A. **Performance Bond**: The OWNER's requirements as to performance bonds are as set forth in the Modifications to General Conditions (Document 00 73 03). Specific requirements are set forth in the Performance Bond (Document 00 61 13).
 - 1. The form of the Bond should be carefully examined by the Bidder.
 - 2. When the successful Bidder delivers the executed Construction Contract to OWNER, it must be accompanied by the required Performance and Payment Bonds.
- B. **Payment Bond**: The OWNER's requirements as to payment bonds are as set forth in the Modifications to General Conditions (Document 00 73 03). Specific requirements are set forth in the Payment Bond (Document 00 61 14).
 - 1. The form of the Bond should be carefully examined by the Bidder.
 - 2. When the successful Bidder delivers the executed Construction Contract to OWNER, it must be accompanied by the required Performance and Payment Bonds.
- C. Certificate of Insurance: The OWNER's requirements as to insurance are as set forth in the Modifications to General Conditions (Document 00 73 03).
- D. Status Verification System Affidavit: The OWNER's requirements as to immigration status verification are set forth in the Modifications to General Conditions (Document 00 73 03). Specific requirements are set forth in the Status Verification System Affidavit (Document 00 45 37).
- E. **Other Information**: When a determination has been made to award the Construction Contract, Bidder is required, prior to the award or after the award, or both, to furnish such other information as the ENGINEER requests.

3.7 SIGNING OF AGREEMENT

- A. Within ten (10) calendar days after OWNER issues Notice of Intent to Award the Construction Contract to the successful Bidder, the Bidder shall pick up, sign and return to OWNER, the required number of copies of the Agreement (Document 00 52 00), bonds, insurance, and Status Verification System Affidavit: A minimum of four (4) originals will be signed and returned to the OWNER. One executed original will be returned to the Bidder. Bidder shall comply with all execution requirements.
- B. All of Bidder's executions and submittals must be delivered to the OWNER before OWNER will execute the Construction Contract. The Construction Contract will not be deemed awarded and shall not be binding on the OWNER until it has been approved and executed by the OWNER, and a fully executed copy is formally delivered to the CONTRACTOR. The OWNER reserves the right to rescind its Notice of Intent to Award without liability, except for the return of Bidder's Bid Security, at any time before the Construction Contract has been fully executed by all parties and delivered to the CONTRACTOR.
- C. Transfers, delegations or assignments of interests in the Contract Documents are prohibited, unless prior written authorization is received from the OWNER.

- D. At the time of Bidding, and the signing of the Agreement, and at all times during the Work, Bidder shall be properly licensed to do the Work and shall be in compliance with the license laws of the State of Utah, Provo City and Utah County. The Bidder shall also require all Subcontractors to do the same.
- E. If a Bidder fails to fully and properly execute the Construction Contract and provide all submittals required therewith within ten (10) calendar days after the date of the Notice of Intent to Award, the OWNER may elect to rescind the Notice of Intent to Award, and the OWNER shall be entitled to the full amount of Bidder's Bid Security, not as a penalty, but in liquidation of and compensation for damages sustained. In the OWNER's sole discretion, a Notice of Intent to Award may then be provided to another bidder whose Bid is most advantageous to the OWNER, price and other factors considered.

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DOCUMENT 00320 GEOTECHNICAL DATA

PART 1 GENERAL

1.1 REPORTS OF EXPLORATIONS AND TESTS

- A. In preparing the Drawings and Specifications, ENGINEER has relied upon the following geotechnical reports of explorations and tests of subsurface conditions at or contiguous to the Work site.
 - 1. Report dated May 2, 2019 prepared by Intermountain GeoEnvironmental Services, Inc. entitled: GEOTECHNICAL INVESTIGATION REPORT Provo Waste Water Reclamation Facility Provo, Utah consisting of 802 pages.
- B. Accuracy: For the purposes of bidding or construction, the Bidder may rely upon the accuracy of the geotechnical data at the locations where the data was obtained and to the depths indicated, but not upon any other information, interpretations or opinions contained in the geotechnical data itemized above or for the completeness thereof expressed or implied.
- C. Geotechnical Data Not a Part of the Contract Documents: Geotechnical data itemized above are not a part of the Contract Documents, but the technical data contained therein upon which Bidder is entitled to rely as provided in Article 4.02 of the General Conditions (Document 00 72 00) are incorporated by reference.

1.2 DRAWINGS OF SURFACE AND SUBSURFACE STRUCTURES

- A. In the preparation of Drawings and Specifications, ENGINEER has relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Work site.
 - 1. Drawings dated 1953 prepared by Templeton and Linke, Consulting Engineers entitled: Provo City, Utah Sewage Treatment Plant consisting of 37 pages
 - 2. Drawings dated 1976 prepared by Horrocks and Carollo Engineers, a Joint Venture entitled: Wastewater Treatment Facilities consisting of 228 pages.
 - Drawings dated 1990 prepared by James M. Montgomery Consulting Engineers, Inc. entitled: Volume II – Drawings for the Construction of Water Reclamation Plant Improvements – Headworks and Grit Chamber Additions consisting of 40 pages.
 - 4. Drawings dated 1995 prepared by Horrocks Carollo Engineers, Inc. entitled: Provo City Corporation Water Resources Department Biosolids Facilities Upgrades consisting of 30 pages.

- 5. Drawings dated 2014 prepared by Aqua Engineering, Inc. entitled: Provo City Water Reclamation Facility Headworks, Anaerobic Digesters and UV Disinfection Upgrade consisting of 162 pages.
- Drawings dated 2024 prepared by Water Works Engineers, LLC entitled: Provo Water Reclamation Center Phase 1, Package 1 2020 Construction Volume 2 As Built Documents
- Drawings dated 2024 prepared by Water Works Engineers, LLC entitled: Provo Water Reclamation Center Phase 1, Package 1 2020 Construction Volume 2 As Built Documents
- Drawings dated 2022 prepared by Water Works Engineers, LLC entitled: Provo WATRR Center Phase 1, Package 2 2020 Construction Volume 2A 100% Submittal: Revisions for Permitting Changes
- B. Drawings Not a Part of the Contract Documents: Drawings itemized above are not a part of the Contract Documents. Location of the surface and subsurface structures and utilities are further described in Article 4.3 of the General Conditions (Document 00 72 00).

1.3 EXAMINATION OF DATA

A. Copies of the Geotechnical Report & Drawings of surface structures and subsurface structures may be examined by appointment during regular business hours at 1377 South 350 East, Provo, Utah.

END OF DOCUMENT

DOCUMENT 00 39 12 NOTICE OF INTENT TO AWARD

То: _____

PROJECT DESCRIPTION: <u>Provo City Water Reclamation Facility Phase 1, Electrical Re-</u> Feed Packages A-E, Bid #PROVOEN202529386.

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids called: <u>Provo City Water Reclamation Facility Phase</u> **1**, Electrical Re-Feed Packages A-E, Bid #PROVOEN202529386.

You are hereby notified that your BID has been accepted for items in the amount of:

<u>\$_____</u>.

In order to execute the contract, all documents as specified in Document 00 21 13 - 3.6 shall be submitted to the OWNER within seven (7) calendar days of the receipt of this NOTICE OF INTENT TO AWARD.

You are required to return an acknowledged copy of this NOTICE OF INTENT TO AWARD to the OWNER. Dated this _____ day of _____.

PROVO CITY CORPORATION
Owner

By

Title

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF INTENT TO AWARD is hereby acknowledged

By			

this the _____day of _____, ____

Ву

Title _____

END OF DOCUMENT

Notice of Intent to Award 00 39 12 - 2

DOCUMENT 00 39 13 NOTICE TO PROCEED

То:

Date:

PROJECT DESCRIPTION: <u>Provo City Water Reclamation Facility Phase 1, Electrical Re-</u> <u>Feed Packages A-E, Bid #PROVOEN202529386.</u>

You are hereby notified to commence work in accordance with the Agreement dated					
	on or before		and you are to complete		
the WORK on or before			. The date of completion of all WORK is		
therefore					

PROVO CITY CORPORATION

Owner

By

Title

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

By_____

this the _____day of _____, ____

By_____

Title _____

END OF DOCUMENT

Notice to Proceed 00 39 13 - 1

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DOCUMENT 00 41 00 BID FORM

PART 1 GENERAL

1.1 BID PROPOSAL

- A. After having personally and carefully examined all conditions surrounding the Work and the Contract Documents, the undersigned proposes to furnish all labor, equipment, tools and machinery and to furnish and deliver all materials not specifically mentioned as being furnished by the OWNER, which is required in and about the construction of the Construction Contract known as **Provo City Water Reclamation Facility Electrical Re-feed Packages A-E, Bid No. PROVOEN202529386.**
- B. The undersigned proposes to complete the Work for the price or prices listed in the Bid Schedule (Document 00 43 00) and understands that quantities for Unit Price Work are not guaranteed.
- C. The undersigned proposes to furnish bonds with the Contract, signed by a surety company satisfactory to the OWNER, in an amount equal to the Contract amount conditioned to insure compliance with all requirements of the Contract Documents.
- D. The undersigned encloses a certified check, cashier's check, cash, or a Bid Bond for Dollars (\$)

which is five (5) percent of the Bid amount payable to the OWNER, as a guarantee of good faith, and which it is agreed will be forfeited to the OWNER as liquidated damages in the event of the failure of the undersigned to enter into a contract and furnish satisfactory bonds to the OWNER.

- E. The undersigned proposes to execute the attached contract within ten (10) days after the Notice of Intention to Award, and to begin work within ten (10) days after being notified to do so by the OWNER.
- F. The undersigned agrees the Bid is genuine. The Bid is not made in the interest of or on behalf of any undisclosed person, firm or corporation. The undersigned agrees that they have not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid: that they have not solicited or induced any person, firm or corporation to refrain from bidding: and that they have not sought by collusion to obtain for itself any other advantage over any separate Bidder or over OWNER.
- G. If OWNER finds it necessary to further define the Work, Contract Price, Contract Time or some other portion of the Construction Contract, after Bid opening, the Bidder promises to execute an Agreement Supplement prior to or concurrent with the execution of the Agreement, if the Agreement Supplement is acceptable to the Bidder.
- H. It is understood that the OWNER has the right to reject this proposal or to accept it at the prices listed in the Bid Schedule.

PART 2 EXECUTION

2.1 **BIDDER**

2.2

A. The Bidder is as follows

	Name:
	Address:
	Telephone number:
	Email address:
	Tax identification number:
B.	Bidder holds license number, issued on theday of,, by the Utah State Department of Commerce, Division of Occupational and Professional Licensing. Bidder is licensed to practice as aContractor. License renewal date is theday of,
C.	The undersigned hereby acknowledges receipt of the following Addenda.
	(list Addenda numbers here)
BII	DDER'S SUBSCRIPTION
A.	Date:
B.	Bidder's Signature:
C.	Please print Bidder's name here:

D. Title:

END OF DOCUMENT

DOCUMENT 00 42 00 BID BOND

PART 1 GENERAL

1.1 **PROCEDURE**

A. For filing purposes, add Bid Bond to the Contract Documents following this page.

END OF DOCUMENT

Bid Bond 00 42 00 - 1

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DOCUMENT 00 43 00 BID SCHEDULE

PART 1 GENERAL

1.1 DOCUMENT INCLUDES

- A. Price schedules.
- B. Measurement and payment provisions.

1.2 CONSTRUCTION CONTRACT

A. The Construction Contract is known as Project.

1.3 **REFERENCES**

- A. APWA 01 29 00: Payment Procedures (as published in Document 01 29 00 in the Manual of Standard Specifications by the Utah Chapter of the American Public Works Association, and included herein by reference.
- B. Document 00 52 00: Agreement.

1.4 SCHEDULES TO BE ADDED TO THE AGREEMENT

A. This document will be added to the Agreement by reference.

PART 2 PRICE SCHEDULES

SCHEDULE A - BASE BID

Item			Quantity	
No.	Area	Description	Unit	Total Cost ¹
1	Package A: Primary Sludge Pump Station No. 2 (S2) Re-feed	 Demolition and Replacement the Primary Sludge Pump Station No. 2 MCC – "C". Installation of feeds from Power Distribution Building Load Center PB- CLC-001 to New Primary Sludge Pump Station No. 2 MCC-C. Installation of HVAC equipment at Primary Sludge Pump Station No. 2 to meet the requirements of NFPA-820 for that facility. 	1 Lump Sum	\$
2	Package B: Influent PS / Load Center 1 & Dewatering Building Re- feeds	 Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 1 (EIP-3). Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001to Load Center No. 1 (EIP-3). Replacement and installation of a new low-profile pad mounted switchgear and 500KVA pad mounted transformer. 	l Lump Sum	\$
3	Package C: Headworks Building Re- feeds	Installation of new electrical feed from Pad-Mounted Switchgear SE-NSX- 001A to Headworks Building Automatic Transfer Switch via H-MCB-001A	1 Lump Sum	\$

Item			Quantity	
No.	Area	Description	Unit	Total Cost ¹
4	Package D: Chlorine Building / Load Center 4 Re-feed	 Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 4 located at the Chlorine Building. Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001 to Load Center No. 4 located at the Chlorine Building. 	1 Lump Sum	\$
5	Package E: Existing Blower / Load Cetner 2 Re-feed	 Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 2 and No. 3 located at the Existing Blower Building. Installation of new electrical feed from Pad-Mounted Switchgear SE-NSG- 001A to Load Center No. 2 located at the Existing Blower Building. 		
Bid Schedule Total (Sum of Total Costs of Items 1-5)				\$

Bid Schedule Total In Words:

¹The total cost is the sum of the equipment, materials, and installation costs. All costs shall include all labor equipment, tools, supplies, insurance, taxes, overhead, markups, applicable fees, and all other costs associated with performing the work. These costs shall be distributed fairly among the bid items according to their relative amounts and not weighted or unbalanced.

PART 3 MEASUREMENT AND PAYMENT

3.1 GENERAL

- A. Units of measurement are listed above in the price schedule(s).
- B. See measurement and payment procedures in APWA Section 01 29 00.
- C. ENGINEER will take all measurements and compute all quantities.
- D. CONTRACTOR will verify ENGINEER's measurements and computations.
- E. CONTRACTOR will provide all equipment, workers, and survey crews to assist ENGINEER in making measurements.

Bid Schedule 00 43 00 - 3

- F. Assets, equipment and other installations damaged by CONTRACTOR will be replaced at no additional cost to OWNER.
- G. If ENGINEER determines existing assets or equipment need to be replaced, the asset or equipment will be provided by either the OWNER or CONTRACTOR. If supplied by CONTRACTOR, the item will be paid for by using prices agreed to in a Change Order.
- H. CONTRACTOR shall be responsible for the preservation of neighboring facilities not being demolished, if damage occurs during construction proper restoration of all damage is required at no additional cost. All shall be included in the Bid Item.

DOCUMENT 00 43 36 PROPOSED SUBCONTRACTOR FORM

PART 1 GENERAL

1.1 **BIDDER**

A.	Name:
	Address:
D	Talanhana Numbar:

1.2 CONSTRUCTION CONTRACT

A. The Construction Contract is known as Provo City Water Reclamation Facility, Phase 1 Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.

PART 2 REPORT

2.1 SUBCONTRACTOR AND SUPPLIER REPORT

- A. Failure of the Bidder to specify a Subcontractor for any portion of the Work constitutes an agreement by the Bidder that the Bidder is fully qualified to perform that portion, and that Bidder shall perform that portion.
- B. Bidder will be fully responsible to OWNER for the acts and omissions of Subcontractors and Suppliers and of persons either directly or indirectly employed by them, as Bidder is for the acts and omissions of persons employed by Bidder directly.
- C. Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor or Supplier and the OWNER. Bidder agrees each subcontract with Bidder's Subcontractor will disclaim any third party or direct relationship between OWNER and any Subcontractor or Supplier.
- D. The names and addresses of the Subcontractors and Suppliers who will work under the terms of the Contract Documents and the estimated dollar amount of each subcontract (in excess of 2 percent of the Bid sum) are set forth as follows.

SUBCONTRACTORS					
Name and Address	Nature and Extent of Work to be Sublet	Amount			
1.					
2.					
3.					
	SUPPLIERS				
Name and Address	Name and AddressNature and Extent of Work to be SubletAmount				
1.					
2.					
3.					
4.					

Table 1 – BASE BID

PART 3 EXECUTION

3.1 EFFECTIVE DATE

A. Bidder executes this Subcontractor and Supplier report and declares it to be a supplement to the Bid and in effect as of ______, ____.

3.2 BIDDER'S SUBSCRIPTION

- A. Bidder's signature:
- B. Please print Bidder's name here:
- C. Title:

END OF DOCUMENT

Proposed Subcontractor Form 00 43 36 - 2

DOCUMENT 00 43 38 BIDDER STATUS FORM

PART 1 GENERAL

1.1 **BIDDER**

А.	Name:
B.	Address:
C.	Telephone number:
D.	Federal Tax ID Number:

1.2 CONSTRUCTION CONTRACT

A. The Construction Contract is known as Provo City Water Reclamation Facility Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.

PART 2 REPORT

2.1 BIDDER STATUS REPORT

- A. Bidder affirms the following information is true and correct.
 - 1. Number of employees:
 - 2. Bidder's firm is: (check the following as applicable)
 - □ Independently owned and operated.
 - \Box An affiliate of*
 - $\hfill\square$ A subsidiary of *
 - \Box A division of*
 - □ A business with gross revenue in excess of \$ _____
 - □ A business with gross revenue below \$_____

* PARENT COMPANY:

Name: _____

Address:______
Telephone Number:______
Facsimile Number: ______
PART 3 EXECUTION

3.1 EFFECTIVE DATE

A. Bidder executes this status report and declares it to be a supplement to the Bid and in effect as of ______, ____.

3.2 **BIDDER'S SUBSCRIPTION**

- A. Bidder's Signature:
- B. Please print Bidder's name here:
- C. Title:

END OF DOCUMENT

DOCUMENT 00 45 37 STATUS VERIFICATION SYSTEM AFFIDAVIT

PART 1 GENERAL

1.1 CONTRACTOR

- A. Name: _____
- B. Address:
- C. Telephone number:
- D. Facsimile number:

1.2 OWNER

A. The name of the OWNER is Provo City Corporation

1.3 CONSTRUCTION CONTRACT

A. The Construction Contract is known as Provo City Water Reclamation Facility, Bid No. PROVOEN202529386.

PART 2 REQUIREMENTS

2.1 REGISTRATION AND PARTICIPATION

- A. Bidder has completed a status verification system registration process and is in compliance with the requirements of Utah Code Section 63G-12-302.
- B. Bidder will supply their Company Information page from the status verification system's website (screen shot of enrollment or company information page). The Company Information page shall be submitted in conjunction with this Document 00 45 37 – Status Verification System Affidavit.
- C. Bidder will require similar affidavits of registration and participation, as well as Company Information pages from a status verification system website, for any subcontractor who works under the terms of these Contract Documents.

PART 3 EXECUTION

3.1 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT

A. CONTRACTOR's signature:				
B. CONTRACTOR's Status Verificat	tion System ID Number:			
C. Please print name here:				
D. Title:				
E. CONTRACTOR's Utah license nu	mber:			
А	cknowledgment			
State of:)				
) ss County of:)				
The foregoing instrument was acknowl	edged before me this, 201			
by (person acknowledging and title or representative capacity, if any).				
Notary's signature	_			

Residing at

My commission expires:

Notary's seal

END OF DOCUMENT

DOCUMENT 00 45 38 NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State	of)	
County of) ss.	
		being first duly sworn deposes and	says that:
(1)	He is (Owner, partner, of the Bidder that has su	of fficer, representative or agent) bmitted the attached Bid;	,
(2)	He is fully informed pertinent circumstance	respecting the preparation and contents of the attac es respecting such Bid;	hed Bid and of all
(3)	Such Bid is genuine	nd is not a collusive or sham Bid;	
(4)	Neither the said Bidder nor any of its officers, partners, owner, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price of any other Bidder, or to secure through any collusion, conspiracy connivance or unlawful agreement any advantage against the <u>Provo City Corporation</u> or any person interested in the proposed Contract; and		
(5)	The price or prices quany collusion, conspi any of its agents, repr affiant	noted in the attached Bid are fair and proper and are racy, connivance or unlawful agreement on the par esentatives, owners, employees, or parties in intere Signed	e not tainted by t of the Bidder or est, including this
Suba	wibed and awarn to befo	(Title)	
this	day of	, 20	
	(Title)		
My co	ommission expires:		
	Nc	END OF DOCUMENT n-Collusion Affidavit Of Prime Bidder	

00 45 38 - 1

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DOCUMENT 00 52 00 AGREEMENT

PART 1 GENERAL

1.1 CONTRACTOR

A.	Name:
B.	Address:
C.	Telephone number:
D.	Facsimile number or Email Address:

1.2 OWNER

A. The name of the OWNER is Provo City Corporation.

1.3 CONSTRUCTION CONTRACT

A. The Construction Contract is known as Provo City Water Reclamation Facility Phase 1 Electrical Refeed Packages A-E Bid No. PROVOEN202529386.

1.4 ENGINEER

A. Water Works Engineers, LLC is the OWNER's representative and agent for this Construction Contract who has the rights, authority and duties assigned to the ENGINEER in the Contract Documents.

1.5 REPRESENTATION REGARDING ETHICAL STANDARDS FOR CITY OFFICERS AND EMPLOYEES AND FORMER CITY OFFICERS AND EMPLOYEES

- A. CONTRACTOR represents that it has not:
 - 1. Provided an illegal gift or payoff to a City officer or employee or former City officer or employee, or his or her relative or business entity.
 - 2. Retained any person to solicit or secure this contract upon an agreement or understanding for a commission, percentage, or brokerage or contingent fee, other than bona fide employees or bona fide commercial selling agencies for the purpose of securing business.

Agreement 00 52 00 - 1

1.6 IMMIGRATION STATUS VERIFICATION

A. The Parties recognize the statutory requirements of Utah Code Annotated 63G 12 302 that prohibits City from entering into any contract for the performance of services with any entity that does not register with and participate in a federally approved immigration status verification system to ensure that the entity's employees are legally authorized to work in the United States. As the provider of services on behalf of City, in accordance with Utah Code 63G-12-302, Company certifies that it does not and will not during the performance of this contract knowingly employ, or subcontract with any entity which employs, workers who are not legally authorized to work in the United States. Company agrees to require all its employees to provide proof of their eligibility to work in the United States and agrees to use all reasonable means to verify that proof. Company acknowledges that failure to participate in a status verification program may be grounds for termination of this Agreement.

PART 2 TIME AND MONEY CONSIDERATIONS

2.1 CONTRACT PRICE

- A. The Contract Price includes the cost of the Work specified in the Contract Documents, plus the cost of all bonds, insurance, permits, fees, and all charges, expenses or assessments of whatever kind or character.
- B. The Schedules of Prices awarded from the Bid Schedule (Document 00 43 00) are as follows.
 - 1. Schedule A- Base Bid
- C. An Agreement Supplement is not attached to this Agreement.
- D. Based upon the above awarded schedules and the Agreement Supplement (if any), the Contract Price awarded is: ______ dollars and ______ cents. (\$______).

2.2 CONTRACT TIME

- A. Substantial Completion of the Work shall occur:
 - 1. by_____.
- B. Any time specified in work sequences in the Summary of Work shall be a part of the Contract Time.
- C. The OWNER anticipates that a Notice to Proceed will be given on the following date, but reserves the right to change such date:

Anticipated date of Notice to Proceed:

Agreement 00 52 00 - 2

2.3 PUNCH LIST TIME

- A. The Work will be complete and ready for final payment within 30 days after the date CONTRACTOR receives ENGINEER's Final Inspection Punch List unless exemptions of specific items are granted by ENGINEER in writing or an exception has been specified in the Contract Documents.
- B. Permitting the CONTRACTOR to continue and finish the Work or any part of the Work after the time fixed for its completion, or after the date to which the time for completion may have been extended, whether or not a new completion date is established, shall in no way operate as a waiver on the part of the OWNER of any of OWNER's rights under this Agreement.

2.4 LIQUIDATED DAMAGES

- A. Time is the essence of the Contract Documents. CONTRACTOR agrees that OWNER will suffer damage or financial loss if the Work is not completed on time or within any time extensions allowed in accordance with Part 12 of the General Conditions. CONTRACTOR and OWNER agree that proof of the exact amount of any such damage or loss is difficult to determine. Accordingly, instead of requiring any such proof of damage or specific financial loss for late completion, CONTRACTOR agrees to pay the following sums to the OWNER as liquidated damages and not as a penalty.
 - 1. Late Contract Time Completion: Five hundred dollars and zero cents (\$500.00) for each day or part thereof that expires after the Contract Time until the Work is accepted as Substantially Complete as provided in Article 14.5 of the General Conditions.
 - 2. Late Punch List Time Completion: 50% of the amount specified for Late Contract Time Completion for each day or part thereof if the Work remains incomplete after the Punch List Time. The Punch List shall be considered delivered on the date it is transmitted by email, hand delivery or received by the CONTRACTOR by certified mail.
 - 3. Interruption of Public Services: No interruption of public services shall be caused by CONTRACTOR, its agents or employees, without the ENGINEER's prior written approval. OWNER and CONTRACTOR agree that in the event OWNER suffers damages from such interruption, the amount of liquidated damages stipulated below shall not be deemed to be a limitation upon OWNER's right to recover the full amount of such damages. Five hundred dollars and zero cents (\$500.00) for each day or part thereof of any utility interruption caused by the CONTRACTOR without the ENGINEER's prior written authorization.
- B. **Survey Monuments**: No land survey monument shall be disturbed or moved until ENGINEER has been properly notified and the ENGINEER's surveyor has referenced the survey monument for resetting. The parties agree that upon such an unauthorized disturbance it is difficult to determine the damages from such a disturbance, and the parties agree that CONTRACTOR will pay as liquidated damages the sum of \$1,000.00 to cover such damage and expense.

Agreement 00 52 00 - 3 C. **Deduct Damages from Moneys Owed CONTRACTOR**: OWNER shall be entitled to deduct and retain liquidated damages out of any money which may be due or become due the CONTRACTOR. To the extent that the liquidated damages exceed any amounts that would otherwise be due the CONTRACTOR, the CONTRACTOR shall be liable for such amounts and shall return such excess to the OWNER.

2.5 RIGHT OF OWNER TO TERMINATE CONTRACT

- A. Owner, upon written notice, may terminate this Contract, or any part hereof, as a result of the Contractor's failure to render to the satisfaction of Owner, the material, work and/or services required of it, including progress of the work and such abandonment or termination shall not be deemed a breach by Owner. Owner shall be the sole determinant in all termination for cause issues. The Contractor shall not be entitled, nor shall Owner give any consideration to claims for any costs or for loss of anticipated revenue(s), including overhead and profit, due to the abandonment or termination of this Contract, or any part hereof, by Owner for cause.
- B. Upon receipt of written notification from Owner that this Contract, or any part hereof, is to be terminated, the Contractor shall immediately cease operation of the work stipulated, and assemble all material that has been prepared, developed, furnished or obtained under the provisions of this Contract that may be in its possession or custody, and shall transmit the same to Owner on or before the fifteenth day following the receipt of the above-written notice of termination, together with its evaluation of the cost of the work performed. The Contractor shall be entitled to just and equitable payment in accordance with this Contract for any uncompensated work satisfactorily performed prior to such notice.
- C. Owner shall determine the amount of work satisfactorily performed by the Contractor and Owner's evaluation shall be used as a basis to determine the amount of compensation due the Contractor for this work.
- D. Termination by Owner for cause, default, or negligence on the part of the Contractor shall be excluded from the foregoing provision; termination costs shall not apply. Owner reserves the right to make award in whole or in part on all items, or on all of the items, which are in the best interests of the Owner.
- E. In addition to termination for cause as set forth herein, Provo City reserves the right to terminate this contract at any time for its own convenience upon written notice. In such circumstances, Provo City shall pay to contractor all amounts due for work satisfactorily performed up to the point of termination and contractor shall vacate the worksite without delay.

PART 3 EXECUTION

3.1 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT

(person acknowledging and the title or representative capacity, if any).

Notary's signature

Residing at

My commission expires:

Notary's seal

3.2 OWNER'S SUBSCRIPTION AND ATTESTATION

A. Reviewed by Project Engineer:

(Project Engineer)

B. OWNER: Provo City Corporation

(Mayor's Signature)

C. Attest

(SEAL)

D. Address for giving notices:
 Provo City Corporation
 Engineering Division
 1377 South 350 East
 Provo, Utah 84606

3.3 EFFECTIVE DATE

OWNER and CONTRACTOR execute this Agreement and declare it in effect as of the _____day of ______, ____.

END OF DOCUMENT

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DOCUMENT 00 52 01 AGREEMENT AMENDMENT

PART 1 GENERAL

1.1 PROCEDURE

A. For filing purposes, add Agreement Amendments to the Contract Documents following this page.

END OF DOCUMENT

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DOCUMENT 00 61 13 PERFORMANCE BOND

PART 1 GENERAL				
1.1	BO	ND		
	A.	Number:		
	B.	Amount:		
		Dollars (\$)		
1.2	SU	RETY		
	A.	Name:		
	B.	Address:		
	C.	Telephone number:		
	D.	Facsimile number or Email Address:		
1.3	CO	NTRACTOR		
	A.	Name:		
	B.	Address:		
	C.	Telephone number:		
	D.	Facsimile number or Email Adress:		
1.4	ov	VNER		
	A.	Provo City Corporation		
1.5	CO	INSTRUCTION CONTRACT		
	A.	The Construction Contract is known as Provo City Water Reclamation Facility Phase 1 Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.		

Performance Bond 00 61 13 - 1

1.6 **DEFINED TERMS**

A. Terms used in this Performance Bond which are defined in Article 1.1 of the General Conditions (Document 00 72 00) will have the meanings indicated in the General Conditions.

PART 2 COVENANTS

2.1 SURETY'S AND CONTRACTOR'S RELATIONSHIP

- A. Surety as surety, and CONTRACTOR as principal, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the OWNER as obligee, for the performance of the Construction Contract, whether awarded or about to be awarded.
- B. If CONTRACTOR performs the Construction Contract, the Surety and the CONTRACTOR shall have no obligation under this Bond, except to participate in conferences indicated in Article 2.3.

2.2 NOTICE

- A. Notice to the Surety, the OWNER or the CONTRACTOR shall be sent by certified mail, facsimile, or hand delivered to the address shown on this Bond agreement.
- B. Notices sent as required by paragraph 2.2A shall be effective on the date on which such notice was sent.
- C. Notice may be sent by facsimile. Facsimile notice shall be effective on the date of transmission provided that a confirmation establishing the successful transmission of the notice is sent by first-class mail, postage prepaid, along with a copy of the notice transmitted, no later than twenty-four (24) hours after the facsimile notice is transmitted.
- D. If any notice requires a period of less than seven (7) days for response, the notice shall be sent by facsimile.
- E. If the time for response to any notice expires on a Saturday, Sunday or a legal holiday in the State of Utah, the time shall be extended to the next working day.

2.3 PROCEDURE TO INVOKE SURETY'S OBLIGATION

- A. If the CONTRACTOR fails to perform or to comply with the terms of the Construction Contract, and such failure to perform or to comply has not been waived by the OWNER, the OWNER may notify the CONTRACTOR and the Surety, at their addresses described above, that the OWNER is considering declaring the CONTRACTOR in default.
- B. Before declaring the default, the OWNER shall request and attempt to arrange a conference with the CONTRACTOR and the Surety to be held at a time and place required by the OWNER to discuss methods of performing the Work.

Performance Bond 00 61 13 - 2

- C. If the CONTRACTOR does not attend the conference or agree to cure any deficiencies in the CONTRACTOR's performance of the Work to the satisfaction of the OWNER, the OWNER may declare the CONTRACTOR in default and formally terminate the CONTRACTOR's right to complete the Work. Such default shall not be declared earlier than 10 days after the CONTRACTOR and the Surety have received notice as provided in article 2.2.
- D. If the Contract with the CONTRACTOR is terminated, the OWNER agrees to pay the unpaid Balance of the Contract Price to the Surety for completion of the Work in accordance with the terms of the Construction Contract or to a contractor selected by the Surety to perform the Work in accordance with the terms of the Construction Contract.

2.4 SURETY'S OPTIONS AT CONTRACTOR TERMINATION

- A. Surety Completes the Work: The Surety may undertake to perform and complete the Work itself, through its agents or through independent contractors.
- B. Surety Obtains Bids or Proposals: The Surety may obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Work.
 - 1. Such bids or proposals shall be prepared by the Surety for execution by the OWNER and the completion contractor selected.
 - 2. Surety shall secure the contract with Performance and Payment Bonds executed by a qualified surety equivalent to this Performance Bond and the Payment Bond (Document 00 61 14); and
 - 3. Surety shall pay to the OWNER the amount of damages as described in paragraph 2.6 in excess of the balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR's default.
 - 4. Surety to Pay OWNER: Surety may determine the amount not to exceed the amount of this bond specified in paragraph 1.1B, for which Surety believes it may be liable to pay, and tender payment therefore to the OWNER. OWNER has sole discretion to accept payment. If the OWNER refuses the payment tendered, or the Surety has denied liability in whole or in part, without further notice the OWNER shall be entitled to enforce any remedy available to the OWNER.

2.5 PROCEDURE FOR OWNER TO DECLARE SURETY IN DEFAULT

- A. The OWNER may declare the Surety to be in default upon the following procedures.
 - 1. The OWNER shall issue an additional written notice to the Surety, after declaring the CONTRACTOR in default as provided in Article 2.3, demanding that the Surety perform its obligations under this Bond.
 - 2. Surety shall respond to the OWNER within 15 days after receipt of the OWNER's additional notice, either denying the claim or accepting liability and exercising its' options under Article 2.4.

2.6 SURETY'S OBLIGATIONS

- A. After the OWNER has terminated the CONTRACTOR's right to complete the Construction Contract, and if the Surety elects to complete the Construction Contract as provided in Article 2.4, then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Construction Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER to the Surety shall not be greater than those of the OWNER to the Surety shall not be greater than those of the OWNER to the Surety shall not be greater than those of the OWNER to the Surety shall not be greater than those of the OWNER to the Surety shall not be greater than those of the OWNER under the Construction Contract.
- B. To the limit of the amount of this Bond, but subject to commitment by the OWNER to pay all valid and proper payments made to or on behalf of the CONTRACTOR under the Construction Contract, the Surety is obligated, without duplication, for:
 - 1. the responsibilities of the CONTRACTOR for correction of Defective Work and completion of the Construction Contract;
 - 2. design professional and delay costs resulting from the CONTRACTOR's default, and resulting from the actions or failure to act of the Surety under article 2.4; and
 - 3. liquidated damages which are or may become due for any reason.

2.7 UNRELATED OBLIGATIONS OF THE CONTRACTOR

- A. The Surety and the OWNER shall not be liable to others for obligations of the CONTRACTOR that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or changed on account of any such unrelated obligations.
- B. No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs, executors, administrators, or successors.

2.8 SURETY WAIVES NOTICE OF ANY CHANGE

A. Surety hereby waives notice of any change, including changes of Contract Time, Contract Price and scope of Work, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

2.9 VENUE

A. Any suit or action commenced by OWNER under this Bond shall be for action in a court of competent jurisdiction in the State of Utah.

PART 3 EXECUTION

3.1 EFFECTIVE DATE

A. Surety and CONTRACTOR execute this Bond agreement and declare it to be in effect as of the _____ day of ______.
3.2 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT

A.	Type of organization:				
	(corporation, partnership, individual, etc.)				
B. If CONTRACTOR is a corporation, attach a corporate resolution evidencing CONT TOR's authority to sign.					
C.	. CONTRACTOR's signature:				
D.	Please print name here:				
E.	Title:				
F.	Notary Acknowledgement: In the Country of, State of, on theday of, 20, the foregoing instrument was acknowledged before me				
	(person acknowledging and the title or representative capacity, if any).				
	Notary's signature				
	Residing at				

My commission expires:

Notary's seal

3.3 SURETY'S SUBSCRIPTION AND ACKNOWLEDGMENT

- A. Attach evidence of Surety's corporate authority to sign.

Notary Public signature

Notary Public seal

END OF DOCUMENT

Performance Bond 00 61 13 - 6

DOCUMENT 00 61 14 PAYMENT BOND

PART 1 GENERAL				
1.1	BO	OND		
	A.	Number:		
	B.	Amount:		
		Dollars (\$)		
1.2	SU	RETY		
	A.	Name:		
	B.	Address:		
	C.	Telephone number:		
	D.	Facsimile number:		
1.3	CO	CONTRACTOR		
	A.	Name:		
	B.	Address:		
	C.	Telephone number:		
	D.	Facsimile number:		
1.4	OV	VNER		
	A.	Provo City Corporation		
1.5	CO	DNSTRUCTION CONTRACT		
	٨	The Construction Contract is Improve as Drave City Water Declamation Easility. Dhase 1		

A. The Construction Contract is known as Provo City Water Reclamation Facility, Phase 1, Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.

Payment Bond 00 61 14 - 1

1.6 **DEFINED TERMS**

A. Terms used in this Performance Bond which are defined in Article 1.1 of the General Conditions (Document 00 72 00) will have the meanings indicated in the General Conditions.

PART 2 COVENANTS

2.1 SURETY'S AND CONTRACTOR'S RELATIONSHIP

- A. Surety as surety, and CONTRACTOR as principal, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the OWNER as obligee, for the performance of the Construction Contract, whether awarded or about to be awarded.
- B. If CONTRACTOR performs the Construction Contract, the Surety and the CONTRACTOR shall have no obligation under this Bond.

2.2 NOTICE

- A. Notice to the Surety, the OWNER or the CONTRACTOR shall be sent by certified mail, facsimile, or hand delivered to the address shown on this Bond agreement.
- B. Notices sent as required by paragraph 2.2A shall be effective on the date on which such notice was sent.
- C. Notice may be sent by facsimile. Facsimile notice shall be effective on the date of transmission provided that a confirmation establishing the successful transmission of the notice is sent by first-class mail, postage prepaid, along with a copy of the notice transmitted, no later than twenty-four (24) hours after the facsimile notice is transmitted.
- D. If any notice requires a period of less than seven (7) days for response, the notice shall be sent by facsimile.
- E. If the time for response to any notice expires on a Saturday, Sunday or a legal holiday in the State of Utah, the time shall be extended to the next working day.

2.3 CONDITIONS OF SURETY'S LIABILITY

- A. With respect to the OWNER, this Bond agreement shall be null and void if the CONTRACTOR promptly takes the following actions:
 - 1. promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2. defends, indemnifies and saves harmless the OWNER from all claims, demands, Liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Work, provided the OWNER has tendered defense of such claims, demands, liens or suits to the CONTRACTOR and the Surety.

Payment Bond 00 61 14 - 2

2.4 PROCEDURE TO INVOKE SURETY'S OBLIGATION

- A. **Concerning Claimants who have a Direct Contract with the CONTRACTOR**: The Surety shall have no obligation to Claimants under this Bond who are employed by or have a direct contract with the CONTRACTOR until Claimants have given notice to the Surety at the address shown on this Bond agreement and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
- B. Concerning Claimant who does not have a Direct Contract with the CONTRACTOR: The Surety shall have no obligation to Claimant under this Bond who does not have a direct contract with the CONTRACTOR until Claimant takes the following actions.
 - 1. The Claimant shall furnish written notice to the CONTRACTOR and send a copy, or notice thereof, to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed.
 - 2. The Claimant shall have either received a rejection in whole or in part from the CONTRACTOR, or not received within 15 days of furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR has indicated the claim will be paid directly or indirectly.
 - 3. Not having been paid within the above 15 days, the Claimant shall have sent a written notice to the Surety at the address described on this Bond agreement and sent a copy, or notice thereof, to the OWNER stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR.

2.5 SURETY'S OPTION TO SETTLE CLAIMS

- A. When the Claimant has satisfied the conditions of article 2.4, the Surety shall promptly and at the Surety's expense take the following actions.
 - 1. Send an answer to the Claimant, with a copy to the OWNER, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 2. Pay or arrange for payment of any undisputed amounts.

2.6 SURETY'S OBLIGATION

A. Surety's total obligations under this bond shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

2.7 USE OF FUNDS

- A. Amounts owed by OWNER to CONTRACTOR under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, against the Performance Bond (Document 00 61 13). By the CONTRACTOR furnishing and the OWNER accepting this Bond, they agree that all funds earned by the CONTRACTOR in the performance of the Work are dedicated as follows:
 - 1. The OWNER has first priority to use the funds for the completion of the Work.
 - 2. The CONTRACTOR and the Surety have second priority to use the funds to satisfy the obligations of the CONTRACTOR and the Surety under this Bond.

2.8 UNRELATED OBLIGATIONS OF THE CONTRACTOR

- A. The Surety and the OWNER shall not be liable to Claimants or others for obligations of the CONTRACTOR that are unrelated to the Construction Contract.
- B. The OWNER shall not be liable for payment of any damages, costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

2.9 SURETY WAIVES NOTICE OF ANY CHANGE

A. Surety hereby waives notice of any change to the Construction Contract including changes of Contract Time, Contract Price, and scope of Work, or to related subcontracts, purchase orders or other obligations.

2.10 **VENUE**

A. Any suit or action commenced by a Claimant under this Bond shall be for action in a court of competent jurisdiction in the State of Utah.

2.11 COPIES OF THIS BOND

A. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the CONTRACTOR or OWNER shall promptly furnish a copy of this Bond or shall permit a copy to be made.

PART 3 EXECUTION

3.1 EFFECTIVE DATE

A. Surety and CONTRACTOR execute this Bond agreement and declare it to be in effect as of the _____ day of ______, ____.

3.2 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT

A.	Type of organization:				
	(corporation, partnership, individual, etc.)				
B. If CONTRACTOR is a corporation, attach a corporate resolution evidencing CONT TOR's authority to sign.					
C.	. CONTRACTOR's signature:				
D.	Please print name here:				
E.	Title:				
F.	Notary Acknowledgement: In the Country of, State of, on theday of, 20, the foregoing instrument was acknowledged before me				
	(person acknowledging and the title or representative capacity, if any).				
	Notary's signature				
	Residing at				

My commission expires:

Notary's seal

3.3 SURETY'S SUBSCRIPTION AND ACKNOWLEDGMENT

- A. Attach evidence of Surety's corporate authority to sign.

Notary's signature

Residing at

My commission expires:

Notary's seal

END OF DOCUMENT

DOCUMENT 00 62 16 CERTIFICATE OF INSURANCE

PART 1 GENERAL

1.1 **PROCEDURE**

- A. For filing purposes, add Certificates of Insurance to the Contract Documents following this page.
- B. Certificates of Insurance must include all requirements in Section 5.2 of the Modifications to General Conditions (Supplementary Conditions) (Document 00 73 00M).

END OF DOCUMENT

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DOCUMENT 00 73 00M MODIFICATIONS TO GENERAL CONDITIONS (Supplementary Conditions)

This document changes provisions specified in the General Conditions in the <u>Manual of Standard</u> <u>Specifications</u> published by the Utah Chapter of the American Public Works Association.

Add the following paragraphs to Article 2.2 COPIES OF DOCUMENTS:

- B. OWNER shall not furnish to CONTRACTOR published Contract Documents which include the <u>Manual of Standard Plans</u> and the <u>Manual of Standard Specifications</u>. Such documents shall be purchased separately by the CONTRACTOR.
- C. Copies of all Contract Documents including the <u>Manual of Standard Plans</u> and the <u>Manual of Standard Specifications</u> shall be provided on site by the CONTRACTOR.

Delete Article 2.5, paragraph C and replace with the following:

C. Field Office: An on-site field office is not required; however, CONTRACTOR shall provide and maintain a telephone in the field during performance of the Work such that ENGINEER may always contact CONTRACTOR for transmittal of plans, instructions and dissemination of project information.

Delete Article 5.1 PERFORMANCE, PAYMENT, AND OTHER BONDS in its entirety and replace with the following:

5.1 PERFORMANCE, PAYMENT AND OTHER BONDS

- A. Prior to OWNER executing the Agreement, CONTRACTOR shall file with the OWNER a good and sufficient performance Bond and a payment Bond, each in the sum of not less than 100 percent of the Contract Price/Agreement.
- B. The Bonds shall be executed by the CONTRACTOR and secured by a company duly and regularly authorized to do a general surety business in the State of Utah and either (i) named in the current U.S. Treasury Department's listing of approved sureties (Department Circular 570) (as amended) with an underwriting limitation equal to or greater than the Contract Price which the Bond guarantees, or (ii) with a current "A-" rating or better in A.M. Best Co., Inc's. <u>Best Insurance Reports, Property and Casualty Edition</u>.
- C. The Performance Bond shall guarantee the faithful performance of the Construction Contract by the CONTRACTOR and the payment Bond shall guarantee the payment of labor and materials. The Bonds shall inure by their terms to the benefit of the OWNER. Neither this nor any other provision requiring a performance Bond shall be construed to create any rights in any third party Claimant as against the OWNER for performance of the Work under the Construction Contract.
- D. All Bonds required by the Contract Documents to be purchased and maintained by CONTRACTOR shall be obtained from surety companies that are duly licensed or

Modifications to General Conditions 00 73 00M - 1 authorized in the jurisdiction in which the Project is located to issue Bonds for the limits so required. Such surety companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary General Conditions.

- E. If the surety on any Bond furnished by CONTRACTOR is subject to any proceeding under the Bankruptcy Code (Title 11, United States Code) or becomes insolvent or its right to do business is terminated in the State of Utah or it ceases to meet the requirements of this Article, CONTRACTOR shall, within 15 days thereafter, substitute another Bond and surety, both of which must be acceptable to OWNER.
- F. CONTRACTOR shall provide a Bid Bond equal to 5% of the contract bid.

Delete Article 5.2 INSURANCE in its entirety and replace with the following:

5.2 INSURANCE

- A. CONTRACTOR shall procure and maintain for the duration of the contract, insurance against claims for injuries to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the contracting party, his agents, representatives, employees or SUBCONTRACTORs. The cost of such insurance shall be included in the Contracting party's proposal.
- B. The CONTRACTOR shall not commence Work under this Agreement until all of the insurance required herein shall have been obtained by the CONTRACTOR. The CONTRACTOR shall furnish to the Owner Certificates of Insurance verifying that such insurance has been obtained. Such certificates will provide that Owner will receive at least thirty (30) days prior written notice of any material change in, cancellation of, or non-renewal of such insurance.
- C. Required Insurance Policies and Bonds: CONTRACTOR (the CONTRACTOR) shall maintain or cause to be maintained on its behalf insurance policies of the types required below with insurance companies authorized to do business in the State of Utah, (i) having a Best Insurance Reports rating of "A" or better and a financial size category of "X" or higher, or (ii) otherwise being acceptable to the City with coverage limits and provisions at least sufficient to satisfy the requirements set forth below. All sureties shall be listed in the Department of the Treasury Circular 570, with bond amounts not exceeding the 'underwriting limitation' amount.
 - 1. Workers' Compensation Insurance: Statutory workers' compensation insurance (Part A). Such insurance shall also include employer's liability (Part B) insurance in a limit of not less than <u>\$1,000,000</u> for each: accident, disease, employee. No owner or officer may be excluded.
 - 2. <u>General Liability Insurance:</u> Commercial general liability insurance on an occurrence basis arising out of claims for bodily injury (including death) and property damage. Such insurance shall provide coverage for ongoing operations and products-completed operations, blanket contractual, broad form property damage, personal and advertising injury, independent CONTRACTORS and sudden and accidental pollution liability with not less than \$2,000,000 per occurrence limit combined bodily injury and property damage, with not less than

Modifications to General Conditions 00 73 00M - 2 \$3,000,000 aggregate limit, provided the general policy aggregate shall apply separately to the CONTRACTOR on a per project basis. Any aggregate limit that does not apply separately to the premises shall be at least double the required per occurrence limit.

- 3. <u>Automobile Liability Insurance:</u> Automobile liability insurance for the CONTRACTOR's liability arising out of the use of owned (if any), leased (if any), non-owned and hired vehicles of the CONTRACTOR, with no less than <u>\$3,000,000</u> limit per accident for combined bodily injury and property damage and containing appropriate no-fault insurance provisions wherever applicable. All owned and/or leased automobiles shall be covered using symbol "1" (any auto).
- 4. <u>Excess Liability Insurance:</u> The amounts of insurance required in the foregoing subsections (1), (2), (3) this subsection may be satisfied by the CONTRACTOR purchasing coverage in the amounts specified or by any combination of primary and excess insurance, so long as the total amount of insurance meets the required limits specified above. Evidence of excess liability or umbrella policies shall include a schedule of underling coverages.
- 5. <u>Professional Liability (Technology Errors & Omissions):</u> Professional Liability Insurance (Technology Errors & Omissions insurance) for CONTRACTOR's liability arising out of the rending professional service, including design, programming, security and any other information technology related work in an amount not less than \$3,000,000 each claim, \$3,000,000 aggregate. CONTRACTOR shall provide a certificate of insurance verifying coverage for a period of not less than three years after project completion.
- 6. <u>CONTRACTOR's Professional Liability (Errors & Omissions):</u> Professional Liability Insurance (Errors & Omissions insurance) for CONTRACTOR's liability arising out of the rending professional services, including faulty workmanship, or any other professional service, including construction management and design related work in an amount not less than \$3,000,000 each claim, \$3,000,000 aggregate. CONTRACTOR shall provide a certificate of insurance verifying coverage for a period of not less than three years after project completion.

7. INSURANCE PROVISIONS:

- a. Additional Insurance endorsements: All policies of liability insurance required to be maintained by the CONTRACTOR shall be endorsed to name the City as additional insured for ongoing operations (ISO CG 20 10 or equivalent) and completed operations (ISO CG 20 37 or equivalent) (except for insurance policies required in previous Section [1,3,5,6,7).
- a. **Primary and Non-Contributory Endorsements:** The CONTRACTOR's insurance coverage shall be a primary insurance as respects to the City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees or volunteers shall be in excess of the contracting party's insurance and shall not contribute with it.

- b. Waiver of Subrogation Endorsements: The CONTRACTOR hereby waives any and every claim for recovery from the City, Lenders and their respective offices and employees for any and all loss or damage covered by any of the insurance policies to be maintained under this CONTRACTOR agreement to the extent that such loss or damage is recovered under any such policy. To the extent the foregoing waiver would preclude coverage under any insurance required by this Section, the CONTRACTOR shall give written notice of the terms of such waiver to each insurance company which has issued, or which may issue in the future, any such policy of insurance (if such notice is required by the insurance policy) and shall cause each such insurance policy to be properly endorsed, or to otherwise contain one or more provisions that prevent the invalidation of the insurance coverage by reason of such a waiver.
- c. Severability of Interests:_The contracting party's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respects to the limits of the insurer's liability.
- d. **Deductibles and Self-Insured Retentions:** Any deductibles or self-insured retention, exceeding 5% limit of policy, must be declared to and approved by the City. At the option of the City, either; the insurer may be required to reduce or eliminate such deductibles or self-insured retention as respects the City, its officers, officials and employees; or the contracting party may be required to procure a bond guaranteeing payment of losses and related investigations, claim distribution and defense expenses.
- e. Notice of Incident or Accident: Contracting party shall agree to disclose to the City, all incidents or occurrences of accident, injury, and/or property damage, regardless of whether such incidents are submitted as claims under the CONTRACTOR's insurance policies.
- f. Evidence and Verification of Insurance: On or before the effective date of each policy and on an annual basis at least 10 days prior to each policy anniversary, the CONTRACTOR shall furnish the City with (1) certificates of insurance or binders, in a form acceptable to the City, evidencing all of the insurance required by the provisions of this Section. CONTRACTOR shall provide a certificate of insurance verifying completed operations coverage for a period of not less than two years after project completion. Certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements are to be furnished to and accepted by the City before work commences. The City reserves the right to require complete, certified copies of all required insurance policies, with all endorsements, at any time.
- g. **Claims-Made Policies:** If any policy is a claims-made policy, the policy shall provide the CONTRACTOR the right to purchase, upon cancellation or termination by refusal to renew the policy, an extended reporting period (Tail)

of not less than two years. The CONTRACTOR agrees to purchase such an extended reporting period if needed to ensure continuity of coverage. The CONTRACTOR's failure to purchase such an extended reporting period as required by this paragraph shall not relieve it of any liability under this Contract. If the policy is a claims-made policy, the retroactive date of any such policy shall be not later than the date this Contract is executed by the parties hereto. If the CONTRACTOR purchases a subsequent claims-made policy in place of any prior claims-made policy, the retroactive date of such subsequent policy shall be no later than the date this Contract is executed by the parties hereto.

- h. **Policy Cancellation and Change:** All insurance policies shall be endorsed so that if at any time they are canceled, such cancellation shall not be effective for the City for 30 days, except for non-payment of premium which shall be for 10 days. If any material change in coverage should occur, the CONTRACTOR shall provide notice of any material change in coverage to the City immediately.
- i. Liability Limits: The liability limits shown in this Section are minimum requirements. To the extent the CONTRACTOR maintains, or causes to be maintained on its behalf, liability limits which are higher than the minimum limits stated in this Section, the higher liability limits shall be required of the CONTRACTOR.
- j. Failure to Maintain Insurance: In the event the CONTRACTOR fails, or fails to cause others on their behalf, to take out or maintain the full insurance coverage required by this Section, the City, upon 30 days' prior notice (unless the required insurance would lapse within such period, in which event notice will be given as soon as reasonably possible) to the CONTRACTOR of any such failure, may (but shall not be obligated to) take out the required policies of insurance and pay the premiums on the same. All amounts so advanced thereof by the City shall become an additional obligation of the CONTRACTOR to the City, and the CONTRACTOR shall pay such amounts to the City, together with interest thereon from the date so advanced. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the City, its officers, officials, employees or volunteers.
- k. No Duty to Verify or Review: No provision of this Section or any provision of any Document related to this agreement shall impose on the City any duty or obligation to verify the existence or adequacy of the insurance coverage maintained by the CONTRACTOR, nor shall City be responsible for any representations or warranties made by or on behalf of the CONTRACTOR to any insurance company or underwriter. Any failure on the part of the City to pursue or obtain the evidence of insurance required by this agreement from the CONTRACTOR and/or failure of the City to point out any non-compliance of

such evidence of insurance shall not constitute a waiver of any of the insurance requirements in this agreement.

- 1. **Subcontractors:** CONTRACTOR shall include all SUBCONTRACTORS as an insured under its policies or shall furnish separate certificates and endorsements for each SUBCONTRACTOR. All coverages for SUBCONTRACTORs shall be subject to the requirements stated herein.
- m. **Indemnification / Liability:** CONTRACTOR shall indemnify and hold harmless the City, its officers, agents, employees and volunteers from all damages, costs or expenses in law or equity, including attorney's fees, that may at any time arise or be set up because of damages to property, bodily injury or personal injury received by reason of or in the course of providing services to the City but only to the extent caused by any willful, negligent or wrongful act or omission of the contracting party, any of their employees or any SUBCONTRACTORs.
- n. Loss Control and Safety: The CONTRACTOR shall retain control over its employees, agents, servants, and SUBCONTRACTORs, as well as control over its invitees, and its activities on and about the subject premises and the manner in which such activities shall be undertaken and to that end, the CONTRACTOR shall not be deemed to be an agent of the City. Precaution shall be exercised at all times by the CONTRACTOR for the protection of all persons, including employees and property. The CONTRACTOR shall make special effort to detect hazards and shall take prompt action where loss control/safety measures should reasonably be expected.

Add the following paragraphs to Article 6.8 LAWS AND REGULATIONS

C. All Bidders are required to follow the requirements of Utah Code Annotated 63G-12-302 which prohibits the OWNER from entering into any contract for the physical performance of services with any successful bidder who does not first provide the OWNER with proof of registration and participation in a federally approved immigration status verification system to ensure that their employees are legally authorized to work in the United States. Failure to provide the required proof may be grounds for rejection of an otherwise successful bid. By submitting a bid in response to this RFB, CONTRACTOR certifies that it does not, and will not during the performance of this contract, knowingly employ, or subcontract with any entity which employs workers who are not legally authorized to work in the United States. CONTRACTOR agrees to require all its employees to provide proof of their eligibility to work in the United States and agrees to use all reasonable means to verify that proof. CONTRACTOR further agrees to require any subCONTRACTORs engaged to work on the project to sign a Certification of Legal Work Status and submit the Certification to the OWNER prior to any work being performed by the subCONTRACTORs. CONTRACTOR agrees to provide to the OWNER all documents necessary to verify compliance with applicable State and Federal immigration and labor laws. If

> Modifications to General Conditions 00 73 00M - 6

CONTRACTOR knowingly employs workers or subCONTRACTORs in violation of 8 USC § 1324a, such violation shall be cause for unilateral cancellation of the contract between CONTRACTOR and OWNER. In addition, CONTRACTOR may be suspended from participating in future projects with the OWNER. In the event this contract is terminated due to a violation of 8 USC § 1324a by CONTRACTOR or a subCONTRACTOR of CONTRACTOR, CONTRACTOR shall be liable for any and all costs associated with such termination, including, but not limited to, any damages incurred by the OWNER as well as attorney fees. For purposes of compliance, the OWNER requires CONTRACTOR and subCONTRACTORs to use an immigration status verification system such as E-Verify, or other approved system as outlined in Utah Code Annotated 63G-12-302, to verify the employment eligibility of all employees. CONTRACTOR and subCONTRACTORs must maintain up to date documentation of the status verification system inquiry regarding each employee and must provide this information to the OWNER prior to beginning the project.

Delete Article 14.2 APPLICATON FOR PROGRESS PAYMENTS, Paragraph E in its entirety and replace with the following:

- E. **Retainage:** Payments will be made for work and labor performed and materials furnished under the contract according to the schedule of rates and prices and the specifications attached and made a part thereof. Partial payments under the contract will be made at the request of the CONTRACTOR once each month upon partial estimates by the ENGINEER, as hereinafter specified. There will be reserved and retained from monies earned by the CONTRACTOR, as determined by such monthly estimates, a sum equal to ten (10) percent of all amounts of such estimates.
 - Cost of materials, properly stored, protected and insured at the site of the work will be paid on monthly estimates only when so provided for in the special provisions, and then only for the specific materials listed therein for partial payment. In preparing the monthly estimates, advancement will be made therein for ninety percent (90%) of the cost of such materials, as evidenced by invoices to the CONTRACTOR. Advancement will not be made for any item of material amounting to less than five hundred dollars (\$500.00). All materials must conform to the requirements of the specifications; however, advancement for materials will not constitute acceptance, and any faulty material will be condemned although advancement may have been made for same in the estimates. Deductions at the same rates, and equal in amount to the advancements, will be made on the estimates as the material is used.
 - 2. Quantities used for progress estimates shall be considered only as approximate and provisional, and shall be subject to recalculation, adjustment and correction by the ENGINEER in subsequent progress estimates and in final estimates. Inclusion of any quantities in progress estimates, or failure to disapprove the work at the time of progress estimate, shall not be construed as acceptance of the corresponding work or materials.

- 3. In the event that an unforeseen condition beyond the control of the CONTRACTOR will materially delay the final completion of a contract and if the retention of the monies reserved will work undue hardship upon the CONTRACTOR, he may request payment of the retained percentage. If no claims have thus far been filed against the contract and if no taxes have been certified as due or about to become due by the State Tax Commission, the Owner, at its discretion, may pay the retained percentage or so much of it as appears to be proper, but no payment shall be made until the CONTRACTOR will have delivered to the Owner an acceptable bond in the full amount of the retained percentage thereupon released.
- 4. Payment of the retained percentage shall be withheld for a period of thirty (30) days following the final acceptance by the Owner, and shall be paid the CONTRACTOR at the expiration of said thirty (30) days in event no claims, as provided by law, have been filed against such funds; and provided further, that releases have been obtained from the Utah Labor Commission and also, except for contract totaling less than \$20,000.00, the Utah State Tax Commission, the State of Utah Employment Security Department, and all other departments and agencies having jurisdiction over the activities of the CONTRACTOR. In the event such claims are filed, the CONTRACTOR shall be paid such retained percentages less an amount sufficient to pay any such claims, together with a sum sufficient to pay the cost of such action, and to cover attorney fees as determined by the Owner.

END OF DOCUMENT

DOCUMENT 00 91 13 ADDENDA

PART 1 GENERAL

1.1 **PROCEDURE**

A. For filing purposes, add Addenda and Modifications to the Contract Documents following this page.

END OF DOCUMENT

Addenda 00 91 13 - 1

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DOCUMENT 00 92 45 CHANGE ORDER FORM

CHANGE ORDER No.

Project: Provo City Water Reclamation Facility Phase 1 Electrical Refeed Packages A-E,

Bid No. PROVOEN202529386

Date of Issuance:											
Owner: Provo City Corporation Contractor: Owner's Rep: Water Works Engineers, LLC Contact: Jenny Calderon, P.E Project Manager You are directed to make the following changes in the Contract Documents: Description:											
						Purpose of Change Order:					
						Attachments:					
						Change in Contract Price:					
						Driginal Contract Price: \$					
Prior Change Orders No. to No											
Contract Price with all approved Change Orders: \$											
Change to CONTRACT TIME:											
The CONTRACT TIME will be increased by calendar days.											
The date for completion of all work will be(Date)	_·										
Approvals Required: To be effective, this order must be approved by the Federal Agenc objective of the PROJECT, or as may otherwise be required by the GENERAL CONDITIONS.	ey if it changes the scope or e SUPPLEMENTAL										
Recommended By:	, Project Manager										
Approved By:	, Owner										
Accepted By:	, Contractor										

END OF DOCUMENT

Change Order Form 00 92 45 - 2

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION AND DESCRIPTION OF WORK

- A. The Work covers the Electrical Refeed Packages A-E of the Phase 1 2020 Construction of the Provo City Water Reclamation Facility and performing related required work, located as shown in the Electrical Refeed Packages A-E Drawings and Specifications. Electrical Refeed Packages A-E include, but are not limited to:
 - 1. Package A:
 - a. Demolition and Replacement the Primary Sludge Pump Station No. 2 MCC "C".
 - b. Installation of feeds from Power Distribution Building Load Center PB-CLC-001 to New Primary Sludge Pump Station No. 2 MCC-C.
 - c. Installation of HVAC equipment at Primary Sludge Pump Station No. 2 to meet the requirements of NFPA-820 for that facility.
 - 2. Package B:
 - a. Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 1 (EIP-3).
 - b. Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001to Load Center No. 1 (EIP-3).
 - c. Replacement and installation of a new low-profile pad mounted switchgear and 500KVA pad mounted transformer.
 - 3. Package C:
 - a. Installation of new electrical feed from Pad-Mounted Switchgear SE-NSX-001A to Headworks Building Automatic Transfer Switch via H-MCB-001A
 - 4. Package D:
 - a. Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 4 located at the Chlorine Building.
 - b. Installation of new electrical feed from Power Distribution Building Main Utility Switchgear PB-USG-001 to Load Center No. 4 located at the Chlorine Building.
 - 5. Package E:
 - a. Demolition of electrical feed from 12 KV Switchgear at Power Distribution Center to Load Center No. 2 and No. 3 located at the Existing Blower Building.
 - b. Installation of new electrical feed from Pad-Mounted Switchgear SE-NSG-001A to Load Center No. 2 located at the Existing Blower Building.
- B. The CONTRACTOR shall be responsible for the acceptance, handling, installation and startup of all equipment for the Project. The installation of equipment and appurtenances shall be certified by the equipment supplier.
- C. The Work is located at the Provo City Water Reclamation Facility, located at 1685 South East Bay Boulevard, Provo Utah 84606. Work will occur on both the liquid and solid stream treatment processes and associated facilities of the water reclamation facility and will be delivered under separate Packages and Phases of the Work.
- D. The Work completed under Phase 1, Electrical Refeed Packages A-E will be constructed under one contract. The Contract Documents include the following:
 - 1. Provo City Water Reclamation Facility Project Standard Details

01 11 00-1

- 2. Package 2 Volume 1 Provo City Water Reclamation Facility Electrical Refeed Packages A-E Project Specifications
- 3. Package 2 Volume 2 Provo City Water Reclamation Facility Electrical Refeed Packages A-E Project Drawing Sets

1.2 COORDINATION

- A. The CONTRACTOR shall be solely responsible for coordination of all the Work of this Contract.
- B. The CONTRACTOR shall supervise, direct and cooperate fully with all subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the Work within the Contract Time.
- C. Work of Others:
 - 1. The CONTRACTOR shall cooperate with and coordinate CONTRACTOR's Work with the work of other contractors, utility service companies, or OWNER's employees performing work at the site.
 - 2. The CONTRACTOR shall also coordinate their Work with the work of others to assure compliance with schedules.
 - 3. The CONTRACTOR shall attend and participate in all project coordination or progress meetings and report on the progress of all Work and compliance with schedules.
 - 4. If any part of the work depends upon the work of others for proper execution or results, the CONTRACTOR shall inspect and promptly report to the ENGINEER any apparent discrepancies or defects in such work of others that render it unsuitable for such proper execution and results.
 - 5. Failure of the CONTRACTOR to so inspect and report shall constitute an acceptance of the work of others as fit and proper except as to defects which may develop in the work of others after execution of the Work by the CONTRACTOR.
- D. Interference with work on utilities:
 - 1. The CONTRACTOR shall cooperate fully with all utility personnel of the OWNER or personnel of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of facilities which interfere with the progress of the Work.
 - 2. The CONTRACTOR shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities.
- E. Responsibility for Damage:
 - 1. The CONTRACTOR shall not be responsible for damage done by others not under their jurisdiction.
 - 2. The CONTRACTOR will not be liable for any such loss or damage, unless it is through the negligence of the CONTRACTOR.

1.3 WORK BY OTHERS

- A. OWNER will perform the following work:
 - 1. Operation of all existing system valves and equipment, unless specified otherwise.
- B. CONTRACTOR shall be responsible for all other Work. The CONTRACTOR will ensure contractual obligations of installation, commissioning, testing, startup and support are completed by necessary subcontractors and equipment suppliers as defined in

purchasing documents and agreements. CONTRACTOR shall provide installation, commissioning, testing, and startup support for pre-purchased equipment provided by the OWNER.

1.4 SITE CONDITIONS

- A. Site Investigation and Representation
 - 1. The CONTRACTOR acknowledges that it has satisfied itself as to the nature and location of the Work, the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during the prosecution of the work and all other matters which can in any way affect the work or the cost thereof under this Contract.
 - 2. The CONTRACTOR further acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site and from evaluating information derived from exploratory work that may have been done by the OWNER or included in these Contract Documents. Any failure by the CONTRACTOR to become acquainted with all the available information will not relieve the CONTRACTOR from responsibility for properly estimating the difficulty or cost of successfully performing the work.
 - 3. Field Verification:
 - a. Before undertaking each part of the Work, the CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements.
 - b. As the work proceeds, the CONTRACTOR shall field verify the depth and location of all buried utilities, and existing systems, and location of hazardous waste and contaminants.
 - c. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.
- B. Existing Utilities and Improvements
 - 1. Location of Underground Utilities:
 - a. Known existing underground conduits, pipelines and other utilities have been shown on the contract drawings in their approximate locations (within 3 feet of actual location). However, the accuracy or completeness of utilities indicated on the drawings is not guaranteed.
 - b. It shall be the responsibility of the CONTRACTOR to determine the exact location of all utilities and their service connections.
 - c. All potholing or other procedures for verifying utility location shall be performed by the CONTRACTOR as necessary to prepare for excavation at least 4 working days in advance of scheduled excavation.
 - d. The CONTRACTOR shall immediately notify the ENGINEER as to any utility located which has been incorrectly shown or omitted from the drawings.
 - e. If the CONTRACTOR cannot locate an underground utility whose presence is indicated on the Drawings, the ENGINEER shall be notified in writing.
 - f. The CONTRACTOR shall ascertain the exact locations of underground utilities whose presence is indicated on the Drawings, the locations of their service laterals work and of service laterals or appurtenances of any other underground

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utilities which can be inferred from the presence of visible facilities such as buildings, meters and junction boxes prior to doing work that may damage such utilities or interfere with their service.

- g. Utilities Not Shown on Drawings:
 - 1) Attention is directed to the possible existence of underground utilities not indicated on the Drawings and to the possibility that underground utilities may be in a location different from that indicated on the Drawings.
 - 2) If the CONTRACTOR discovers underground utility not indicated on the Drawings, the CONTRACTOR shall immediately give the ENGINEER and the Utility Company written notification of the existence of such utility.
- 2. Utility Coordination:
 - a. The CONTRACTOR shall notify Blue Stakes of Utah 811 at least 2 days prior to excavation, telephone (800) 662-4111.
 - b. The CONTRACTOR shall also contact all utility owners not registered with Blue Stakes of Utah 811 but known to have utilities in the project area to field locate underground utilities at least 2 days prior to excavation.
 - c. The CONTRACTOR shall also coordinate with plant personnel on locations of utilities within the plant site.
 - d. The CONTRACTOR shall notify all owners of utilities when the Work is in progress and shall make arrangements as are necessary to make emergency repairs.
 - e. Existing utilities that are shown or that are made known and located to the CONTRACTOR prior to excavation, and that are to be retained; and all utilities that are constructed during excavation operations shall be properly supported and protected from damage during the progress of the work.
- 3. Utility Protection and Damage:
 - a. Existing utilities that are shown or that are made known and located to the CONTRACTOR prior to excavation, and that are to be retained, and all utilities that are constructed during excavation operations shall be properly supported and protected from damage during the progress of the work.
 - b. Should any damage to a utility occur during the progress of the work, the CONTRACTOR shall notify the OWNER or the utility at once and render all assistance possible to repair the damage and restore the service.
 - c. No extra compensation will be made for the repair of any services or utility damaged by the CONTRACTOR nor for any damage incurred through neglect or failure to provide adequate protection to existing utilities.
 - d. The provisions of this section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.
 - e. Damaged water pipelines will be repaired by the OWNER at the CONTRACTOR's expense. If the CONTRACTOR fails to pay the cost of repairs to water pipelines within thirty days of receipt of the invoice, the OWNER reserves the right to withhold the amount owed from the CONTRACTOR's Progress Payment.
 - f. Damage Report:
 - 1) In the event that the CONTRACTOR damages any underground utilities not shown on the Drawings or not depicted on the Drawings with reasonable accuracy (within 3 feet of actual location) or any lateral service the location of which could not be inferred by the CONTRACTOR, a written report thereof shall be made immediately to the ENGINEER.
 - 2) The CONTRACTOR's report shall also advise the ENGINEER of any schedule delays. Compensation for such delays will be determined in accordance with the General Conditions. The CONTRACTOR shall be entitled to no other compensation for any such damage.

- 4. All utilities encountered along the line of the work shall remain continuously in service during all work under the Contract, unless otherwise shown on the drawings, or unless other arrangements satisfactory to the ENGINEER are made with the owner of said utilities.
- C. CONTRACTOR's Responsibility for Utility Facilities and Service
 - 1. Where the CONTRACTOR's operations could cause damage or inconvenience to railway, telephone, television, power, oil, gas, water, sewer, or irrigation systems, the CONTRACTOR shall make all arrangements necessary for the protection of these utilities and services.
 - 2. The CONTRACTOR shall be solely and directly responsible to the OWNER and operators of such properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.
 - 3. Neither the OWNER nor its officers or agents shall be responsible to the CONTRACTOR for damages as a result of the CONTRACTOR's failure to protect utilities encountered in the work.
 - 4. In no event shall interruption of any utility service be allowed outside working hours unless granted by the owner of the utility.
 - 5. No sand, mud, rocks or other construction debris shall be disposed of in the sanitary sewers or storm sewers.
 - 6. Where bypassing of sewage is required to perform sewer repairs or service relocations and where temporary pumps are required to bypass any sewage across traffic lanes, the discharge lines crossing the traffic lanes shall be buried a minimum of 4 inches below the pavement surface and backfilled with temporary asphalt concrete surfacing. The CONTRACTOR shall take all necessary steps to assure continuous flow of sewage. Bypassing of untreated wastewater to surface waters or courses will not be permitted.
 - 7. The CONTRACTOR shall replace, at its own expense, any and all existing utilities or structures removed or damaged during construction, to their existing condition unless otherwise provided for in these Contract Documents.
 - 8. The CONTRACTOR shall repair or replace, at its own expense, all pavement damaged during the construction, to its existing condition unless otherwise provided for in these Contract Documents.
- D. Names of Known Utilities Serving the Area
 - 1. The following is a list of the known public utilities serving the area:
 - a. Water Provo Public Works (801-852-6700)
 - b. Sewer Provo Public Works (801-852-6700)
 - c. Telephone CenturyLink (800 345-2712)
 - d. Electric Provo Power (801-852-6000)
 - e. Gas Dominion Energy (801-324-5111)
 - f. Fiber Veracity Networks (801-691-5800)
 - g. Fiber Google Fiber (866-777-7550)
- E. Interfering Structures
 - 1. The CONTRACTOR shall take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Drawings. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid possible difficulties.

- 2. The CONTRACTOR shall protect all existing structures, trees, shrubs, and other items on the project site that are to be preserved, by substantial barricades or other devices commensurate with the hazard, from injury or destruction by vehicles, equipment, workmen, or other agents.
- 3. Where existing fences, gates, buildings, or any other structure must be removed to properly carry out the work, or are damaged during the work, they shall be restored at the CONTRACTOR's expense to their original condition or better.
- 4. Without additional compensation, the CONTRACTOR may remove and replace in a condition as good as or better than original, any small structures such as fences, and signposts that interfere with the CONTRACTOR's operations.
- F. Field Relocation
 - 1. During the progress of construction, it is expected that minor relocations of the work will be necessary.
 - 2. Such relocations shall be made only by direction of the ENGINEER.
 - 3. If existing structures are encountered that will prevent construction as shown, notify the ENGINEER before continuing with the work in order that the ENGINEER may make such field revisions as necessary to avoid conflict with the existing structures.
 - 4. If the CONTRACTOR shall fail to notify the ENGINEER when an existing structure is encountered, and shall proceed with the work despite this interference, CONTACTOR shall do so at their own risk.
 - 5. Any CONTRACTOR request(s) for additional compensation or contract time resulting from necessary field relocations that were not included or identified in the Construction Documents will be considered as set forth in the General Conditions.
 - 6. If the CONTRACTOR fails to notify the ENGINEER when a structure which interferes with construction is encountered, and proceeds with the work despite this obstruction, the CONTRACTOR shall do so at their own risk and at no additional cost to the OWNER.

1.5 REFERENCE POINTS AND SURVEYS

- A. Location and elevation of benchmarks are shown on Drawings.
- B. Dimensions for lines and elevations for grades of structures, appurtenances, and utilities are indicated on Drawings, together with other pertinent information required for laying out Work. If conditions vary from those indicated, notify ENGINEER immediately, who will make minor adjustments required.
- C. OWNER or OWNER'S REPRESENTATIVE may perform checks to verify accuracy of CONTRACTOR's layout Work and that completed Work complies with Contract Documents.
- D. Any existing survey points or other control markers destroyed without proper authorization will be replaced by owner of the survey points or control markers at CONTRACTOR's expense.
- E. CONTRACTOR's Responsibilities:
 - 1. Provide all survey and layout required.
 - 2. Locate and protect reference points prior to starting site preparation.
 - 3. Notify OWNER at least 3 working days in advance of time when line and grade to be provided by others will be needed.

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- 4. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
- 5. In event of discrepancy in data provided by OWNER, request clarification before proceeding with Work.
- 6. Provide cut sheets for all staking.
- 7. Preserve and leave undisturbed control staking until ENGINEER has completed checks it deems necessary.
- 8. Re-establish reference points resulting from destruction by CONTRACTOR's operations.
- 9. Cooperate with ENGINEER so that checking and measuring may be accomplished with least interference to CONTRACTOR's operations.

1.6 SEQUENCE AND PROGRESS OF WORK

- A. The CONTRACTOR shall submit a Construction Schedule covering the entire Work in accordance with Section 01 32 13, Progress Schedule.
- B. The CONTRACTOR shall incorporate the requirements of Section 01 13 00, Special Project Constraints, into the Construction Schedule.
- C. Alternate Sequence:
 - 1. The CONTRACTOR's schedule may use a different sequence from that shown or specified, if techniques and methods known to the CONTRACTOR will result in cost and time savings to the OWNER, still achieve the required objective and maintain the same or greater level of treatment.
 - 2. The ENGINEER's determination on the acceptability of any alternative sequence from that shown or specified shall be final.

1.7 CONTRACTOR'S USE OF PREMISES

- A. The CONTRACTOR shall coordinate use of the premises, for the CONTRACTOR's storage and the operations of the CONTRACTOR's workmen, with OWNER and utility service companies.
- B. Restriction of Work Area:
 - 1. The full use of the premises for storage, the operations of workmen and for all other construction activities will not be available to the CONTRACTOR.
 - 2. The CONTRACTOR must operate entirely within the space allowed to the CONTRACTOR.
 - 3. The Drawings defines the area allocated to the CONTRACTOR.
- C. The CONTRACTOR shall be solely responsible for obtaining and paying all costs in connection with any additional work area, storage sites, access to the site or temporary right-of-way, which may be required for proper completion of the Work.
- D. Limitations on Use of Work Area:
 - 1. It shall be understood that responsibility for protection and safe-keeping of equipment and materials on or near the site will be entirely that of the CONTRACTOR and that no claim shall be made against the OWNER or their authorized representatives by reason of any act.
 - 2. It shall be further understood that should any occasion arise necessitating access to the sites occupied by these stored materials or equipment, the ENGINEER shall direct

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the CONTRACTOR owning or responsible for the stored materials and equipment to immediately move the same.

- 3. No materials or equipment may be placed upon the property of the OWNER, other than in the designated areas as shown on the Drawings, unless the ENGINEER has agreed to the location contemplated by the CONTRACTOR to be used for storage.
- 4. All stored materials shall be labeled according to the appropriate contractor or subcontractor with the manufacturer's label as well.
- 5. Appropriate safety data sheets (e.g., SDS) shall be provided.
- E. The CONTRACTOR shall be required to share use of the premises with other Contractors whose services the OWNER has obtained or will obtain for construction of other facilities on the site.

1.8 USE OF OWNER'S FACILITIES

- A. The CONTRACTOR may use existing facilities or equipment in the Work for construction purposes, only if the OWNER's written permission is obtained.
- B. Restore existing facilities and equipment used for temporary purposes to original condition in a manner satisfactory to OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 13 00

SPECIAL PROJECT CONSTRAINTS

PART 1 - GENERAL

1.1 LIMIT OF CONSTRUCTION ACTIVITIES ON WORK SITE

- A. Traffic Control:
 - 1. During project construction, access to all plant areas will need to be maintained. The CONTRACTOR shall provide alternate access routes, backfill trenches, or suitable steel plates (as necessary) to maintain access to all plant areas.

1.2 SEQUENCE OF WORK

- A. General:
 - 1. The CONTRACTOR shall schedule and sequence their work in order to complete the Work by the specified completion date.
 - 2. The OWNER's water reclamation facility and sewer collections system must remain operational at all times.
 - 3. Re-vegetation of graded areas shall take place as quickly as possible as weather permits.

1.3 PROJECT CONSTRAINTS

- A. Maintenance of OWNER's Operations:
 - 1. Constraints listed herein involve limits on activities during construction. These limits relate to the critical nature of the existing wastewater system.
 - Continuous operation of OWNER's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
 - 3. Work Plan:
 - a. The CONTRACTOR shall submit a detailed Work Plan and time schedule for all construction activities that will make it necessary to remove a tank, pipeline, electrical circuit, equipment, structure, road or other facilities from service, including the critical outages identified herein.
 - b. The Work Plan shall, at a minimum, identify:
 - 1) the date and time when each activity will occur,
 - 2) what equipment will be present including standby equipment,
 - 3) what assistance will be required by OWNER's operating personnel,
 - 4) an emergency backup plan identifying what action will be taken if Work cannot be completed within the allotted time, and
 - 5) what individual will be in charge of the activity.
 - c. Submit Work Plan 14 days prior to the scheduled activity.
 - 4. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of OWNER's operations.
 - 5. Shutdowns:
 - a. Coordinate proposed Work with OWNER and facility operations personnel before affecting unit shutdowns. The CONTRACTOR shall provide written confirmation of the shutdown date and time two (2) working days prior to the actual shutdown.

01 13 00-1

- b. Under no circumstances shall the CONTRACTOR cease Work at the end of a normal working day or at the end of a working week if such actions may inadvertently cause a cessation of any facility operating process, in which case, the CONTRACTOR shall remain onsite until necessary work or repairs are complete.
- 6. Do not close lines, open valves or gates, shut down equipment, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after approval of OWNER.
- 7. Do not proceed with Work affecting a facility's operation without obtaining OWNER's advance approval of the need for and duration of such Work.
- B. Relocation of Existing Facilities:
 - 1. During construction, it is expected that minor relocations of Work will be necessary.
 - 2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
 - 3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
 - 4. Perform relocations to minimize downtime of existing facilities.
 - 5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by OWNER.
- C. Overtime:
 - 1. Conduct Work outside regular working hours on prior written consent of OWNER to meet Project schedule and avoid undesirable conditions.
 - 2. All overtime Work by the CONTRACTOR necessary to conform to the requirements of this section and related sections shall be performed by the CONTRACTOR, at no cost to the OWNER and shall be performed in accordance with the General Conditions. The CONTRACTOR shall make no claims for extra compensation as a result thereof.

1.4 SCHEDULED SHUTDOWNS AND CONSTRUCTION SEQUENCING CONSTRAINTS

- A. Scheduled Shutdowns:
 - 1. The scheduled shutdowns during the period of the CONTRACTOR'S Work will be as shown in Table 01 13 00-A
 - 2. All Work requiring the OWNER's facilities to be out-of-service shall be performed during the scheduled shutdowns shown.
 - 3. The OWNER's staff will continue to perform administrative, operation and maintenance functions during shutdowns.
- B. Critical work sequencing constraints are described in this paragraph. Work not specifically covered in this section may, in general, be done anytime during the contract period.

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C. Key work sequencing constraints are detailed in Part 3, Execution:

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Tie-Ins

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01 13 00 - Maintenance of Plant Operations, Table A - Schedule of Tie-Ins				
Tie-In No.	Tie-In Building/Location	Facility Specific Remarks		
1	Refeed Package A: Primary Sludge Pump Station No. 2 Refeed	 Facility can be without power for up to 6 hours. Coordinate startup activities with ENGINEER and OWNER 		
2	Refeed Package B: Influent Pump Station / Load Center 1 & Dewatering Building Re- feeds.	 Influent Pump Station is a critical facility that is in operation 24 hours per day / 7 days per week. VFD for one of the large Influent Pumps (90 Horsepower) in this facility must be on temporary power at all times during scheduled shutdown of this feed. Shutdown of this feed must take place during low-flow period of diurnal flow (between 2AM and 6AM). Facility Power must be restored within 2 hours. 		
3	Refeed Package C: Headworks Building Refeeds	 Headworks is a critical process that is in operation 24 hours per day / 7 days per week. Temporary power must be fed to the step screen wash press panels at all times during a scheduled shutdown. Scheduled shutdown of this feed must take place during low-flow period of diurnal flow (between 2AM and 6AM). Facility power must be restored within 30 minutes. 		
4	Refeed Package D: Chlorine Building / Load Center 4 Re-Feed	 Ultraviolet Disinfection Facility is a critical process that is in operation 24 hours per day / 7 days per week. Temporary power must be fed to the UV Disinfection Facility at all times during a shutdown. Shutdown of this feed must take place during lowflow period of diurnal flow (between 2AM and 6AM). No facility downtime is allowed without a full plant shutdown Full plant shutdown is discouraged. If required, a shutdown must be coordinated in advance. Facility power must be restored within 30-minute. 		
5	Refeed Package E: Existing Blower / Load Center 2 Re-feed	 Process can be without power for a maximum of 5 hours. 		

+ + END OF SECTION + +

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Provo City Provo City Water Reclamation Facility February 2025 Construction Documents Phase 1 Electrical Refeed Packages A-E

01 13 00-4

SECTION 01 29 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 GENERAL

- A. Payment will be made at the price bid for each item listed on the bidding form or as extra work as provided in the General Conditions.
- B. No initial progress payment (other than a single mobilization payment as described in paragraph 1.3 below) will be made prior to acceptance by the ENGINEER of the CPM Construction Schedule, the associated Schedule of Costs, and the list of anticipated submittals.
- C. No subsequent progress payment will be made prior to receipt by the ENGINEER of the monthly update of the Construction Progress Schedule, as specified in Section 01 31 19, Project Meetings and 01 32 13, Progress Schedule.
- D. No subsequent progress payment will be made prior to receipt by the ENGINEER of Certified Payrolls for the previous month.

1.2 SCHEDULE OF COSTS FOR PAYMENTS

- A. Submit to the ENGINEER, within 5 days of acceptance of the Construction Schedule, five (5) copies of a Schedule of Costs. The Schedule of Costs shall be a form showing a detailed breakdown of quantities and prices of work and materials required to perform and complete the contract.
- B. The Schedule of Costs shall provide a cost breakdown for each element detailed in the approved Construction Schedule. The total of the price breakdown must agree with the GMP price bid. The elements listed and price breakdown shall not be front end loaded or unbalanced, shall be subject to adjustment between the ENGINEER and the CONTRACTOR, and will be used as a basis for progress payments.
- C. The Schedule of Costs will be used as a basis for determining the amount of the monthly progress payments.
- D. Acceptance of the Schedule of Costs by the ENGINEER shall not relieve the CONTRACTOR of the responsibility of performing all the work needed to complete the project at the GMP price bid.

1.3 PAYMENT FOR MOBILIZATION

- A. Mobilization Cost Breakdown:
 - 1. As soon as practicable after receipt of the Notice to Proceed, the CONTRACTOR shall submit a breakdown to the ENGINEER for approval, which shall show the estimated value of each major component of mobilization.
 - 2. When approved by the ENGINEER, the breakdown will be the basis for initial progress payments in which mobilization is included.

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- 3. Said breakdown shall not be "front end loaded" or unbalanced.
- B. One CONTRACTOR payment may be made prior to acceptance of the Construction Schedule, Schedule of Costs, and list of anticipated submittals.
 - 1. Payment shall be limited to mobilization items only.
 - 2. The Construction Schedule is described in Section 01 32 13, Progress Schedule.
 - 3. Mobilization items are described in Section 01 71 13, Mobilization.
 - 4. The Schedule of Costs is described in paragraph 1.2 of this Section.
 - 5. The list of anticipated submittals is described in Section 01 33 00, Submittal Procedures.

1.4 PROGRESS PAYMENTS

- A. Progress Payment Request Submittal:
 - 1. Unless otherwise mutually agreed, by the 25th of each month, the CONTRACTOR shall prepare and submit monthly progress payment requests for work completed through the 25th day of the month.
 - 2. Said payment request shall be based on the breakdown of activities as specified in the Schedule of Costs described in paragraph 1.2 above.
 - 3. The monthly schedule update shall be submitted as part of the monthly progress payment report.
- B. The ENGINEER will review progress payment requests and make a determination of the percent completion of all activities (rounded to the nearest whole percent) based on an approximate measurement of all materials supplied and work performed.
- C. In the event that the CONTRACTOR fails to provide the OWNER with an acceptable Monthly Contract Record Drawing Submittal in accordance with Section 01 33 00, Submittal Procedures, the OWNER shall deduct compensation for such monthly submittal as provided in Section 01 32 13, Progress Schedule. Said deduction shall become the sole property of the OWNER.
- D. Retention:
 - 1. From the amount thus determined, five percent thereof will be deducted as retention by OWNER for performance security.
 - 2. Acceptance of separate components shall not operate to release performance retention.
 - 3. The amount of all payments previously made to the CONTRACTOR and any amounts due the OWNER from the CONTRACTOR for supplies, materials, services, damages, or otherwise deductible under the terms of the contract will be deducted from the remainder.
 - 4. The remaining amount will be paid as a progress payment by the OWNER to the CONTRACTOR on the third Friday of the succeeding month or as soon thereafter as is practical.
- E. In addition to the retention under Paragraph D above, the whole or part of any payment of the estimated amount due the CONTRACTOR may be withheld as an additional retention if such course be deemed necessary to protect the OWNER from loss due to the CONTRACTOR's failure to perform any of the following: (1) meet CONTRACTOR's payment obligations; (2) execute the work; (3) correct defective work; (4) settle damages as provided; or (5) produce substantial evidence that no stop notices will or
have been filed, and/or if it has been determined that unpaid balances may be insufficient to complete the work.

- F. All material and work covered by progress payments thereupon become the sole property of the OWNER, but this provision shall not be construed as relieving the CONTRACTOR from sole responsibility for all materials and work upon which payments have been made or the restoration of any damaged work or as a waiver of the OWNER's right to require fulfillment of all of the contract terms. Said CONTRACTOR's obligation extends through the close of the warranty period.
- G. Payment for Materials:
 - 1. No payment shall be made for materials stored offsite.
 - 2. Payment may be made for those materials delivered to the site but not incorporated in the work to the extent that the materials are included in the Construction Schedule as cost-loaded material delivery activities.
 - 3. Only material items manufactured specifically for this project and that cost individually in excess of \$20,000 will be considered for partial payment as stored materials.
 - 4. Partial payment for materials delivered will not be made before the respective shop drawings, installation instructions and O&M manuals have been submitted, reviewed, and accepted in accordance with Section 01 33 00, Submittal Procedures.
 - 5. To receive partial payment for materials delivered to the site, but not incorporated in the work, it shall be necessary for the CONTRACTOR to submit to the ENGINEER, at least 7 days prior to the end of said month, a list of such materials.
 - 6. At their sole discretion, the ENGINEER will approve items for which partial payment is to be made.
 - 7. The list of materials and invoices shall be clearly identified by referencing the associated activity or item on the price breakdown.
 - 8. Partial payment for materials delivered to the site or a bonded warehouse will be made in an amount equal to 75% of the respective suppliers' invoices(s) for the actual net cost for the item(s) delivered plus delivery charges.
 - 9. The CONTRACTOR's actual net cost for the materials must be supported by invoices of suppliers.
 - 10. Proper storage and protection of materials shall be provided by the CONTRACTOR. Final payment shall be made only for materials actually incorporated in the work and, upon acceptance of the work, all materials remaining for which advance payments had been made shall revert to the CONTRACTOR, unless otherwise agreed, and partial payments made for these items shall be deducted from the final payment for the work.

1.5 FINAL PAYMENT AND RELEASE OF CLAIMS

- A. Upon the completion of the work as determined by the ENGINEER, a Notice of Acceptance will be issued and recorded with the State of Utah.
- B. The OWNER will pay to the CONTRACTOR within 35 days after filing of the Notice of Acceptance, or as soon thereafter as practicable, the remaining amount due the CONTRACTOR including retainage, less all prior payments and advances whatsoever to or for the account of the CONTRACTOR for supplies, materials, services, damages, stop notices, or otherwise deductible under the terms of the contract.

- C. All prior estimates and payments including those relating to extra work shall be subject to correction by this payment, which throughout this contract is called "Final Payment".
- 1.6 RELEASE OF CLAIMS:
 - A. Neither the final payment nor any part of the retained percentage shall become due until the CONTRACTOR shall have delivered to the OWNER a complete release of all claims against the OWNER arising under and by virtue of this contract and related to undisputed amounts, including claims of Subcontractors and suppliers of either materials or labor.
 - B. If disputed contract claims in stated amounts are unresolved 35 days after issuance of the Notice of Acceptance, a progress payment of undisputed amounts and retained funds will be made by OWNER upon receipt of a release specifically excluding the disputed contract claims.
 - C. Claims by the OWNER against the CONTRACTOR for liquidated damages or actual damages or other causes will be a valid basis for withholding of funds by the OWNER.
 - D. Upon resolution of disputed claims, the CONTRACTOR shall execute a supplemental release and, upon delivery the OWNER will make final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 19

PROJECT MEETINGS

<u> PART 1 - GENERAL</u>

1.1 PRE-CONSTRUCTION CONFERENCE

- A. Upon receipt of the Notice to Proceed, or at an earlier time if mutually agreeable, the ENGINEER will arrange a preconstruction conference to be attended by the CONTRACTOR's superintendent or other project representative authorized to commit on the behalf of the CONTRACTOR and to direct the performance of the work by others, the OWNER, the ENGINEER or ENGINEER's representative, and representatives of utilities, major subcontractors, and others involved in the execution of the work.
- B. The purpose of this conference will be to establish a working relationship and understanding between the parties and to discuss subjects as may be pertinent for the execution of the work.
- C. CONTRACTOR shall be prepared to discuss the following subjects, as a minimum:
 - 1. Required schedules.
 - 2. Status of Bonds and insurance.
 - 3. Sequencing of critical path work items.
 - 4. Progress payment procedures.
 - 5. Project changes and clarification procedures.
 - 6. Use of site, access, office and storage areas, security and temporary facilities.
 - 7. Major product delivery and priorities.
 - 8. CONTRACTOR's safety plan and representative.
- 1.2 PROGRESS MEETINGS
 - A. The ENGINEER will arrange and conduct progress meetings. The ENGINEER will prepare and circulate a draft agenda of each meeting. The CONTRACTOR may add items as appropriate to the draft agenda.
 - B. Progress meetings will be conducted on a regular basis, at such frequency as the OWNER and CONTRACTOR may mutually agree. Progress meetings shall be attended by the ENGINEER, OWNER representative, PROGRAM MANAGER, CONTRACTOR's superintendent or other project representative, and representatives of all subcontractors involved in the work at the time of the meeting, required by the CONTRACTOR, or requested by the OWNER.
 - C. The purpose of the meetings will be to facilitate the work of the CONTRACTOR and any subcontractor or other organization that is not up to schedule, resolve conflicts, identify and resolve any potential delays or necessary changes in the work and in general, coordinate and facilitate the execution of the work.
 - D. The agenda of progress meetings shall include review of upcoming work and work progress, the latest Construction Schedule submittal (monthly), potential project delays, the status of key shop drawings, submittal reviews, information requests, safety concerns, change orders, record drawings, and extra work items.

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1.3 CONSTRUCTION SCHEDULE REVIEW

- A. The Construction Schedule will be reviewed monthly during an agreed upon progress meeting to verify at a minimum:
 - 1. Actual start and finish dates of completed activities since the last progress meeting.
 - 2. Durations and progress of all activities not completed.
 - 3. Critical submittals/materials delivery problems.
 - 4. Potential project delays.
 - 5. Any activity behind schedule and CONTRACTOR's plan to bring it back on schedule.
 - 6. Reason, logic, time, and cost data for Change Order work that is to be incorporated into the Construction Schedule or payment request form.
 - 7. Payment due to the CONTRACTOR based on percentage complete of items in the submittal payment request form.
- B. At the progress meeting, the CONTRACTOR shall provide an update of the Construction Schedule as described in Section 01 32 13, Progress Schedule.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 32 13

PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work specified in this Section includes the preparation and submittal of a computerized Critical Path Method (CPM) Construction Schedule and of updates and revisions to the Construction Schedule.
- B. The computerized CPM schedule shall be completed using Microsoft Project for Windows or Primavera Project Planner scheduling system and software.
- C. The requirements specified under Section 01 33 00, Submittal Procedures, also apply to the Construction Schedule initial submittal(s) and subsequent updates and revisions.

1.2 REFERENCE

- A. General:
 - 1. Applicable Reference shall be the Associated General Contractors of America (AGC) Publication No. 1107.1, "Construction Planning and Scheduling", latest edition.
 - 2. The preparation of the Construction Schedule, its principles, definitions and terms shall be as set forth in that reference.
 - 3. In case of conflict, the provisions specified in this Section shall govern and supersede conflicting provisions in such reference.

1.3 PREPARATION AND SUBMITTAL PROCEDURE

- A. Responsible Person:
 - 1. Within five days after Notice to Proceed, the CONTRACTOR shall designate, in writing, the person responsible for the preparation of the Construction Schedule.
 - 2. Such person shall have the authority to act on behalf of the CONTRACTOR and be knowledgeable in the preparation of CPM schedules of similar complexity.
 - 3. This person shall meet with the ENGINEER, within 10 days of the Notice to Proceed for a joint review and approval of the CONTRACTOR's approach.
- B. Initial Schedule Submittal:
 - 1. The Construction Schedule shall be completed and submitted to the ENGINEER within 30 days after Notice to Proceed.
 - 2. If the initial Construction Schedule submittal is not acceptable to the ENGINEER, it shall be revised in coordination with observations and comments from the ENGINEER and resubmitted within 7 days of the return of the schedule to the CONTRACTOR.
- C. By preparing and submitting the Construction Schedule the CONTRACTOR represents that the CONTRACTOR can and intends to execute the work and portions thereof within the specified times and constraints and that the CONTRACTOR's bid covers the costs associated with the execution of work in accordance with the Construction Schedule.

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- D. Submittal package.
 - 1. Submittal of the Baseline Construction Schedule shall include the following:
 - a. Network Diagram:
 - 1) A graphic network diagram with legible letters with individual sheets sized approximately 24" by 48".
 - 2) Each activity shall be shown on the diagram with the activity number, description and duration in working days.
 - 3) One (1) copy fitted to 11 x 17 inch sheets and two (2) USB drives shall accompany the submittal with full-size .pdf copies of all network.
 - b. Five sets of supporting data, if not indicated on the graphic network diagram, including:
 - 1) Number of work days per week.
 - 2) Holidays that will be observed during construction.
 - 3) Number of shifts per day.
 - 4) Major construction equipment used identifying the time period and activity of use.
 - 5) Average manpower for each week and for each trade.
 - 6) Lost time allowance for weather or other conditions that can be anticipated.
 - c. Five computer printouts as follows:
 - 1) Listing of all activities sorted by total float including early start (ES), late start (LS), early finish (EF), late finish (LF) and Total Float duration for each activity or work item. Each activity or work item will not take more than two lines.
 - 2) Lists of all activities sorted numerically including ES, LS, EF, LF, Total Float.
 - 3) List of all activities sorted numerically with Predecessor/Successor information of precedence network.
 - 2. Submittals of updated Construction Schedules shall include, in addition to the items specified in the preceding subparagraph 1a, 1c, and 1d, the following:
 - a. Changes in the schedule due to approved Change Order or Change Directives or Force Account work.
 - b. CONTRACTOR elected changes in schedule logic, activity duration, or activity start or stop dates.
 - c. A narrative report as needed to define:
 - 1) Changes in logic, activity duration, and manpower and equipment utilization.
 - 2) Problem areas, anticipated delays, and the impact on the schedule.
 - 3) Corrective action recommended and its effect.
 - 4) The effect of changes on schedules of other contractors involved with the work.
 - 5) Coordination of work with others.
 - d. Percentage completion for each activity as agreed to for the monthly progress payments.
- E. If the Construction Schedule, its updates or its revisions, reflect anything not acceptable by the ENGINEER, such Construction Schedule, update, or revision shall be considered as not having been accepted by the ENGINEER.

1.4 CONSTRUCTION SCHEDULE CONTENT

A. The Construction Schedule shall be calendar-based, time-scaled, manpower and cost-loaded, using a precedence method diagram in the Critical Path Method (CPM) format indicating the critical path for the execution of the work utilizing the entire contract time.

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- 1. In the preparation of the Construction Schedule, the CONTRACTOR shall take into account all constraints and requirements specified.
- 2. Allowance in the Construction Schedule shall be made for normal rainfall, as defined in the General Conditions, and modified by the Supplementary General Conditions.
- 3. The diagram shall be clear, legible, and accurate, and show complete sequence of construction by activity and interdependence of activities. Separate discrete lines shall connect linked activities.
- 4. Activities related to the same physical areas of the work shall be grouped in the same area of the diagram.
- 5. Activities within each area of the work shall be numbered in separate sequential series, with no overlap of activity numbers between different areas of the work.
- 6. The diagram shall clearly show a continuous critical path, all constraints, and all required project milestones.
- The schedule shall describe work activities in appropriate segments so that work in specific areas can be assessed for progress and completion. Activities labeled "start", "continue", or "completion" without measurable increments of work will not be acceptable.
- 8. The individual work activities in the schedule shall:
 - a. Identify major submittals and submittals for long-lead time Critical Path items and associated review times. Twenty (20) working days shall be used for OWNER review times, unless otherwise specified.
 - b. For equipment with a cost in excess of \$20,000 and all control systems the CONTRACTOR shall allow adequate time for an initial submittal and OWNER review plus (at a minimum) a second (re) submittal and associated OWNER review.
 - c. As applicable, identify, at a minimum, the execution of the following as separate items for each area of work.
 - 1) Notice to Proceed.
 - 2) Mobilization.
 - 3) Dewatering.
 - 4) Shoring.
 - 5) Excavation.
 - 6) Pile Driving.
 - 7) Backfill.
 - 8) Grading, subbase, base, paving, and curb and gutters.
 - 9) Other site work.
 - 10) Concrete, including installation of forms and reinforcement, placement of concrete, curing, stripping, patching and finishing.
 - 11) Masonry.
 - 12) Metal fastenings, framing structures, and fabrications.
 - 13) Wood structures, finish carpentry, architectural woodwork, and plastic fabrications.
 - 14) Waterproofing and damp-proofing, insulation, roofing and flashing, and sealants.
 - 15) Doors and windows (including glass walls), including hardware and glazing.
 - 16) Finishes including coating and painting, flooring, ceiling, and wall covering.
 - 17) Building specialties including furnishings, equipment, and toilet and bath accessories.
 - 18) Process equipment, including separate activities for manufacturing, delivery, and installation.
 - 19) Pumps and drives, including separate activities for manufacturing, delivery, and installation.

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- 20) Conveying equipment including hoists and cranes, conveyor systems, and materials handling equipment, including separate activities for manufacturing, delivery and installation.
- 21) Other mechanical equipment including fans and heating, ventilating, and air conditioning equipment, with separate activities for manufacturing, delivery and installation.
- 22) Case work, including separate activities for fabrication, delivery and installation.
- 23) Storage shelving, including separate activities for fabrication, delivery and installation.
- 24) Trenching and pipe laying.
- 25) Piping, including a separate activity for ordering lead time.
- 26) Valves and gates, including a separate activity for ordering lead time.
- 27) Plumbing specialties.
- 28) Electrical transmission, service, and distribution equipment, including separate activities for ordering, manufacturing, delivery, installation.
- 29) Other electrical work including lighting, heating and cooling, and special systems, including separate activities for ordering, manufacturing, delivery and installation.
- 30) Instrumentation and controls, including separate activities for ordering lead time, manufacturing, delivery and installation.
- 31) Separate activities for functional, performance, and operational testing, for each major system.
- 32) Separate activities for operation and maintenance training for each major system.
- 33) Site cleanup.
- 34) Demobilization.
- 35) Procurement of critical (long lead time) equipment.
- 36) Separate activities for design, ordering, delivery and installation of turn key systems.
- 37) Separate activities for Operational Completion, Contract Completion and other contractually required milestones.
- 38) Any items to be OWNER-furnished which are to be incorporated into the work as part of these Contract Documents.
- d. Provide a monthly activity for preparation of Contract Record Drawings, in accordance with Section 01 33 00, Submittal Procedures.
- e. Have a duration of not more than 15 working days.
- 9. Information on each activity shall include:
 - a. Concise description of the activity.
 - b. Duration in working days.
 - c. The dates for the beginning and completion of each activity.
 - d. Total float.
 - e. Numerical designation of work items.
 - f. Cost with a breakdown by labor (by man-hours by trade), materials (by type and quantity), equipment (by type and hours) and overhead and profit.
- 10. The schedule shall be referenced to calendar dates, and the beginning of the contract time shall be the date of receipt of the Notice to Proceed.
- 11. The schedule shall indicate for every month the total dollar amount of work planned in such month. The sum of monthly amounts shall equal the total bid amount.
- B. Failure to include an activity required for the execution of the work shall not excuse the CONTRACTOR from completing the work and portions thereof within the specified times

and at the price specified in the Agreement, and from meeting the constraints specified for sequence of work and control dates.

1.5 UPDATING THE CONSTRUCTION SCHEDULE

- A. The CONTRACTOR shall update the Construction Schedule prior to the progress and schedule review at the monthly progress meetings, as specified in Section 01 31 19, Project Meetings.
- B. The schedule update shall reflect progress to date. The schedule update shall incorporate all revisions to logic and duration, as described below.
- C. The updated Construction Schedule shall be submitted by the CONTRACTOR as specified herein and under paragraph 1.3.D.2 of this Section.
 - 1. Logic changes to the schedule shall be approved by the ENGINEER prior to incorporating them into the schedule.
 - 2. The schedule update submittal shall be provided to the ENGINEER three working days prior to the monthly progress meeting.
 - 3. If at the progress meeting the ENGINEER determines that the updated schedule does not accurately reflect the progress of the work to date or project the anticipated progress to date or is otherwise unacceptable to the OWNER, the CONTRACTOR shall revise the schedule within 5 working days thereafter.
 - 4. If the CONTRACTOR fails to submit to the ENGINEER the updated Construction Schedule, in accordance with the findings at the progress meeting, as described above, or if it is submitted and found unacceptable by the ENGINEER, no monthly progress payment will be made until CONTRACTOR rectifies the unacceptable items.
- D. Updates shall be performed on the most recent accepted version of the Construction Schedule.

1.6 REVISIONS TO CONSTRUCTION SCHEDULE

- A. The cost of revision to the Construction Schedule not resulting from contract change orders shall be borne by the CONTRACTOR.
- B. Except as specified in the preceding Subparagraph A, the cost of revisions to the Construction Schedule resulting from contract change orders in the work shall be included in the cost for the contract change orders.
- C. Corrections resulting from the ENGINEER's review and comments shall be carried out as specified for Construction Schedule update.
- D. Revisions shall be made on the most recent accepted version of the Construction Schedule.

1.7 ADJUSTMENT OF THE CONTRACT TIME AND CHANGE ORDERS

- A. Adjustments of the contract time due to delays, additional work, or any other cause will only be issued through a contract change order in accordance with the General Conditions.
 - 1. In the event the CONTRACTOR requests an adjustment of the contract time, the CONTRACTOR shall furnish such justification, Construction Schedule data, and

supporting evidence as the ENGINEER may deem necessary, for a determination as to whether or not the CONTRACTOR is entitled to an adjustment of time under the provisions of the Contract.

- a. The CONTRACTOR shall submit proof based on revised activity logic, durations, and costs with each request.
- 2. The Construction Schedule shall clearly indicate that the CONTRACTOR has used, in full, all the float time available for the work involved in the request.
- 3. Total and free float is not for the exclusive use or benefit of either the OWNER or the CONTRACTOR but is a resource available to both parties for the benefit of the project on a first needed basis.
- 4. The CONTRACTOR shall not be entitled to additional compensation due to schedule impacts for change order work that extends the contract beyond the scheduled completion date, but not beyond the contract completion date.
- 5. The ENGINEER's determination as to the adjustment of the contract time will be based upon the latest version of the Construction Schedule accepted at the time of the alleged delay, and all other relevant information.
- 6. Actual delays in activities which, according to the Construction Schedule, do not affect the critical path work, will not be the basis of an adjustment to the contract time.
- 7. If the Construction Schedule shows that the project is behind schedule (i.e., has negative float) then no time extensions will be allowed for contract change orders unless they create a critical path delay in excess of that already occurring. In that case, the time extension allowed will only be that amount which exceeds the already occurring delay.
- B. Change Order Requests:
 - 1. The CONTRACTOR shall include, as part of each change order request for which the CONTRACTOR is requesting an adjustment in the contract duration, a subnetwork showing logic revisions, duration changes, and cost changes, for the work in question and its relationship to other activities on the Construction Schedule.
 - 2. The CONTRACTOR shall incorporate each Change Order into the Project Schedule.
- C. The ENGINEER will, within 15 working days after receipt of such request and supporting evidence, review the facts and advise the CONTRACTOR in writing thereof.
- D. The new Construction Schedule data, if accepted by the ENGINEER, shall be included in the next monthly updating of the schedule.
- E. Where the ENGINEER has not yet made a final determination as to the adjustment of the contract time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Construction Schedule, the CONTRACTOR shall reflect that amount of time adjustment in the Construction Schedule as the ENGINEER may determine as appropriate for such interim purpose.
 - 1. It is understood and agreed that any such interim determination by the ENGINEER shall not be binding and shall be made only for the purpose of continuing to schedule the work, until such time as final determination as to any adjustment of the contract time acceptable to the ENGINEER has been made.
 - 2. The CONTRACTOR shall revise the Construction Schedule prepared thereafter in accordance with the final decision.

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

- A. Completely identify each Construction Schedule submittal and resubmittal by showing at least the following information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Name of project as it appears in this Specification and specification number.
 - 3. Whether this is an original or updated submittal or resubmittal.
 - 4. Number all submittals sequentially in accordance with Section 01 33 00, Submittal Procedures.

+ + END OF SECTION + +

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SECTION 01 33 00

SUBMITTAL PROCEDURES

<u> PART 1 - GENERAL</u>

1.1 GENERAL

- A. General:
 - 1. This section outlines in general the items that the CONTRACTOR must prepare or assemble for submittal during the progress of the work.
 - 2. There is no attempt herein to state in detail all the procedures and requirements for each submittal.
 - 3. The CONTRACTOR's attention is directed to the individual specification sections in these Contract Documents, which may contain additional and special submittal requirements.
 - 4. The OWNER reserves the right to direct and modify the procedures and requirements for submittals as necessary to accomplish the specific purpose of each submittal.
 - 5. The CONTRACTOR shall anticipate resubmitting submittals for major pieces of equipment and for control systems.
 - 6. Should the CONTRACTOR be in doubt as to the procedure, purpose, or extent of any submittal, inquiries shall be directed to the ENGINEER.
- B. Schedule of Submittals:
 - 1. Within 30 days of the Notice to Proceed, the CONTRACTOR shall submit a complete list of anticipated submittals, including specification/drawing references.
 - 2. This list shall be updated with "late start" submittal dates within 15 days of submittal of the CONTRACTOR's Construction Schedule.
 - 3. The submittal dates shall be updated upon approval of the Construction Schedule and periodically thereafter.
 - 4. Any additional submittals shall also be included in updates.

1.2 ADMINISTRATIVE SUBMITTALS

- A. The CONTRACTOR is reminded of their obligation as required by law to make required submittals promptly to the applicable federal, state, or local agency. Failure to comply with this requirement may result in the withholding of progress payments and make the CONTRACTOR liable for other prescribed action and sanctions.
- B. The CONTRACTOR shall submit to the ENGINEER a copy of all letters relative to the Contract, transmitting notifications, reports, certifications, and the like, that the CONTRACTOR submits directly to a federal, state, or other governing agency.
- C. During the performance of the Contract, the CONTRACTOR shall maintain on a daily basis, and submit to the ENGINEER as requested, full and correct information as to the number of persons employed in connection with each subdivision of the work, the classification, rate of pay, citizenship status, and address of each person, and the cost, source, and amount of each class of materials delivered, equipment received, and major construction equipment used in each subdivision of the work.

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1.3 TECHNICAL SUBMITTALS

- A. General:
 - 1. Requirements in this section are in addition to any specific requirements for submittals specified in other divisions and sections of these Contract Documents.
 - 2. Submittal Contents and Numbering:
 - a. Each submittal shall contain material pertaining to no more than one equipment or material item and shall have the specification section and applicable paragraph number clearly identified on the front of the submittal transmittal form.
 - b. Each submittal shall be numbered based on the specification number relating to that piece of equipment. For multiple pieces of equipment under one specification section, numbering shall be sequential in the order that they are received (e.g. 40 05 09-00 followed by 40 05 09-01).
 - c. Resubmittals shall include the number of the original submittal plus the suffix "01" for the first resubmittal, "02" for the second resubmittal, etc. (e.g. submittal 40 05 09-01-01, 40 05 09-01-02, etc.).
 - d. Submittals not conforming to these requirements will be rejected.
 - 3. Submitted data shall be fully sufficient in detail for determination of compliance with the provisions and intent of the Contract Documents.
 - 4. Coordination Responsibilities:
 - a. Shop drawing submittal and coordination are the responsibility of the CONTRACTOR; this responsibility shall not be delegated in whole or in part to Subcontractors or Suppliers.
 - b. Designation of work "by others," if shown on shop drawings, shall mean that the work will be the responsibility of the CONTRACTOR rather than the Subcontractor or Supplier who has prepared the shop drawings.
 - 5. No equipment or material requiring listings, drawings, or descriptive material shall be fabricated, purchased, or installed until the ENGINEER has reviewed and accepted such lists, final shop drawings, or other descriptive material. Installation of such equipment or material without accepted submittals will be considered defective work.
 - 6. Submittal Review Time:
 - a. Submittals will be acted upon by the ENGINEER as promptly as possible and returned to the CONTRACTOR not later than the time allowed for review in Paragraph B.2 below.
 - b. The CONTRACTOR shall provide in their Construction Schedule the time for OWNER review of each submittal (and resubmittal for major equipment and control systems) in accordance with the allowable time specified herein and in Section 01 32 13, Progress Schedule.
 - c. This required time for OWNER review shall not be a cause for delay in contract completion nor shall it be a reason for an extension of contract time.
 - d. If the CONTRACTOR is required by the OWNER to resubmit data, then neither the time required for the CONTRACTOR to prepare and resubmit such data, nor the required time for OWNER review, shall be a cause for delay in contract completion or for an extension of contract time.
 - e. Responsibility for time required for preparing and submitting required data shall be assigned solely to the CONTRACTOR.

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7. Excessive Submittal Review:

- a. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the second submission of a submittal item.
- b. Additional costs of the ENGINEER's review beyond the second submission shall be the responsibility of the CONTRACTOR and may be deducted from the monthly progress payments.
- c. This applies to all submittals including shop drawings.
- 8. Changes After Review:
 - a. After a submittal has been reviewed and accepted, no changes or substitutions in that submittal will be allowed without the ENGINEER's approval.
 - b. If allowed, the CONTRACTOR will be responsible for the additional costs for engineering, administrative, clerical or other work required for additional review.
- 9. Intent of Review:
 - a. Shop drawings will be reviewed for general conformance with the drawings and specifications.
 - b. The intent of the review is to determine if the CONTRACTOR is submitting materials and equipment which are in general conformance with the Contract Documents.
 - c. Detailed review of dimensions, sizes, space requirements, coordination with other equipment, and other construction details is not performed.
 - d. Additional work and costs, resulting from errors in the shop drawings shall be the CONTRACTOR's responsibility and liability.
 - e. Accuracy, coordination, and completeness of shop drawings shall be the sole responsibility of the CONTRACTOR, including responsibility to backcheck comments, corrections, and modifications from the ENGINEER's review before fabrication.
- 10. The CONTRACTOR shall indicate on the submittal transmittal form if and how the submittal deviates from the contract requirements.
- 11. Rebar Shop Drawings:
 - a. The CONTRACTOR shall supply the ENGINEER with a copy of all reinforcing steel detail drawings.
 - b. Changes to the Contract Documents made by the CONTRACTOR in reinforcing steel shop drawings shall be called out in the letter of submittal.
 - c. Such changes will not be acceptable unless the ENGINEER has expressed consent to such changes in writing.
- 12. Shop drawings, layout diagrams, catalog cuts and data, test reports, and information in sufficient detail to show complete compliance with all specified requirements shall be furnished to the ENGINEER, covering but not limited to the following items:

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Aggregate Base Course Air compressors Asphalt mixes Block masonry Building specialties Caulking and sealing compounds Chemical systems Concrete mixes Control panels Demolition plan Detection systems Doors and frames

Electrical conduit, wire and specials Electrical fixtures and appliances Electrical load centers Electrical substations Electrical conduit, wire and specials Engineered fill Engines and appurtenances Equipment provided by the CONTRACTOR Fences, barricades and gates Gas monitoring systems Generators and appurtenances Grating Grout Hardware Heating, ventilating and air conditioning equipment Imported fill Instrumentation Landscaping Lights and lighting fixtures Louvers Meters Miscellaneous fabricated metals Motor control centers Motors, starters and controls Paints, coatings and finishes Piles Pipe, fittings and specials Pipe supports and anchors Plumbing fixtures Precast concrete elements Pressure gauges Programmable logic controllers Pumps Reinforcing steel and layout drawings Roofing and waterproofing Sheet pile, shoring and bracing Signs Structural steel Tanks Temporary bypasses Temporary dewatering systems and equipment Valve and gate operators and controllers Valves and gates Variable frequency drives Water heaters Windows Workstations

B. Submittal Procedure:

1. The CONTRACTOR shall submit to the ENGINEER for review one (1) electronic copy of each submittal (shop drawings, electrical diagrams, and catalog cuts for fabricated items and manufactured items furnished under this Contract, etc.)

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- 2. Shop drawings shall be submitted in sufficient time to allow the ENGINEER not less than twenty (20) working days for examining the shop drawings except for designs for turnkey items for which thirty (30) working days will be allowed, and substitutions for which (40) working days will be allowed.
- 3. Shop drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the Contract Drawings and Specifications.
- 4. CONTRACTOR Certification:
 - a. Shop drawings shall be submitted only by the CONTRACTOR, who shall indicate by a signed stamp on the shop drawings, or other approved means, that the CONTRACTOR has checked and approved the shop drawings, and that the work shown is in accordance with Contract requirements and has been checked for dimensions and relationship with work of all other trades involved.
 - b. Submitting incomplete or unchecked shop drawings for the ENGINEER to correct or finish will not be acceptable, and shop drawings that, in the opinion of the ENGINEER, indicate that they have not been checked by the CONTRACTOR will be rejected and returned to the CONTRACTOR for resubmission in the proper form.
- 5. Return of Reviewed Submittals:
 - a. When the shop drawings have been reviewed by the ENGINEER, one (1) electronic copy of each submittal (shop drawings, electrical diagrams, and catalog cuts for fabricated items and manufactured items furnished under this Contract, etc.) will be returned to the CONTRACTOR appropriately stamped.
 - b. If major changes or corrections are necessary, the shop drawing will be rejected and returned to the CONTRACTOR with the need for such changes or corrections indicated.
 - c. The CONTRACTOR shall correct and resubmit rejected shop drawings in the same manner and quantity as specified for the original submittal.
 - d. If changes are made by the CONTRACTOR (in addition to those requested by the ENGINEER) on the resubmitted shop drawings, such changes shall be clearly explained in a transmittal letter accompanying the resubmitted shop drawings.
- 6. The review of such shop drawings and catalog cuts by the ENGINEER shall not relieve the CONTRACTOR from responsibility for correctness of dimensions, fabrication details, coordination with other work, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the CONTRACTOR has called attention to such deviations in writing by a letter accompanying the shop drawings and the ENGINEER approves the change or deviation in writing at the time of submission; nor shall review by the ENGINEER relieve the CONTRACTOR from the responsibility for errors in the shop drawings.
- 7. The CONTRACTOR agrees that shop drawing submittals processed by the ENGINEER do not become Contract Documents and are not Change Orders; that the purpose of the shop drawing review is to establish a reporting procedure and to permit the ENGINEER to monitor the CONTRACTOR's progress and understanding of the design.
- C. Shop Drawing Requirements: Shop drawings referred to herein shall include shop drawings, catalog cuts and information schematic diagrams, and other submittals for both shop and field-fabricated items. The CONTRACTOR shall submit, as applicable, the following for all prefabricated or manufactured structural items, material, and equipment:
 - 1. General:

- a. For structures, submit all shop, setting, equipment, miscellaneous iron and reinforcement drawings and schedules necessary for construction. The foregoing shall include detailed "pour drawings" which shall show the sequence of concrete placement, and the type, quantity and location of all embedment items (sleeves, anchor bolts, door frames, etc.)
- b. For pipelines, submit a detailed layout of the pipeline with details of bends, closure pieces and fabricated specials and furnish any other details necessary.
- c. For trench excavation, submit detailed plan showing the design of shoring, bracing, sloping or other provisions necessary for safety.
- d. For boring and jacking, submit a detailed description of the process to be used.
- e. For equipment which requires electrical service, submit detailed information to show power supply requirements, MCC and control panel, elevations, wiring diagrams, control and protection schematics, shop test data, operation and maintenance procedures, outline drawings, and manufacturer's recommendation of the interface/interlock among the equipment.
- f. For mechanical equipment submit all data pertinent to the installation and maintenance of the equipment including shop drawings, anchorage requirements, manufacturer's recommended installation procedure, detailed installation drawings, test data and curves, operation and maintenance manuals, and other details necessary.
- g. For architectural fabrication submit all data pertinent to the installation of the fabrications, including shop drawings, manufacturer's recommended installation procedure, detailed installation drawings, and other details necessary.
- h. For shop drawings or equipment drawings, include dimensions, size and location of connections to other work, and weight of equipment.
- i. Installation or placing drawings for equipment, drives, and bases.
- j. Supporting calculations for equipment and associated supports, or hangers required or specified to be designed by equipment manufacturers, including seismic restraint information and details.
- k. Complete coating manufacturer's specifications, including materials description and paint system.
- I. Performance data and head vs. flow curves for compressor and pumps.
- m. Suggested spare parts list with current price information.
- n. List of special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)
- o. List of special tools furnished with the equipment.
- p. List of materials and supplies required for the equipment prior to and during startup.
- q. Installation instructions.
- r. List of materials and supplies furnished with the equipment.
- s. Samples of finish colors for selection.
- t. Special handling instructions.
- u. Requirements for storage and protection prior to installation.
- v. Requirements for routine maintenance required prior to plant startup.
- w. Startup and operating instructions.
- x. Seismic design calculations and restraint details for equipment and piping supports. Calculations shall be stamped by a Civil or Structural Engineer registered in the State of Utah.
- 2. Electrical:

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- a. Wiring and control diagrams of systems and equipment. Local control panel details.
- b. List of special motor features being provided (e.g., space heaters, altitude corrections, thermal protectors, mounting arrangement, etc.).
- c. Complete motor rating for all motors, including motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at 110 percent voltage; motor service factor; motor efficiency and power factor at 1/2, 3/4, and full-load at rated voltage; recommended maximum kVAR of power factor correction capacitors when capacitors are switched with motor.
- d. See Division 26, Electrical, for additional specific submittal requirements.
- 3. Instrumentation and Control:
 - a. See technical sections for additional specific submittal requirements.
 - b. The submittals shall include satisfactory identification of items, units, and assemblies in relation to the specification section number, and the system or equipment identification or tag number shown on the Drawings, the Process and Instrumentation Diagram (P&ID), or as provided in applicable specification section.
- D. Submittals required for foreign-manufactured items:
 - 1. In addition to the submittal requirements stated above, suppliers of foreign-manufactured items shall submit the names and addresses of companies within the United States that maintain technical service representatives and a complete inventory of spare parts and accessories for each foreign-made item proposed for incorporation into the work. Failure to provide the foregoing capabilities shall be just cause for rejection of the foreign-manufactured items.
- E. Final shop drawings to be submitted to OWNER:
 - 1. Complete sets of reproducible (One USB drive copy of full size drawings in .pdf format and one full printed set fitted to 11x17 inch sheets) final shop drawings shall be submitted to the OWNER before, or at the time of, delivery of equipment onto the site.
- F. Seismic loading design provisions:
 - 1. All equipment supports that are not specifically detailed on the Drawings or specified herein shall be the responsibility of the equipment manufacturers and shall be designed by a Civil or Structural Engineer registered in the State of Utah.
 - 2. The design shall be in accordance with the seismic provisions of the latest edition of the International Building Code and of the seismic design requirements listed in Section 01 61 00, General Product Requirements, in addition to all other loading conditions.
- G. Submittal of interface information (connection and correlation with other work):
 - 1. Where called for in the Specifications, and as determined necessary by the ENGINEER to provide proper correlation with other equipment, complete interface information shall be submitted.
 - 2. This interface information shall be accurate and contain all information necessary to allow the completion of detailed design and construction of the interfacing or connecting work.
 - 3. The CONTRACTOR shall include in their negotiation for subcontract work, such agreements as may be necessary to ensure the accuracy of Subcontractor's interface submittal information.

- 4. In the event additional costs are incurred due to subsequent changes to information given in said interface information, such additional costs shall be borne by the CONTRACTOR.
- H. Record Drawings
 - The CONTRACTOR shall deliver to the OWNER one complete set of final Record Drawings for OWNER records before the contract will be accepted by the OWNER. The Record Drawings will consist of a set of reproducible drawings of all CONTRACTOR supplied equipment (including control systems) and a marked-up set of Contract Record Drawings.
 - 2. Record Drawings of CONTRACTOR-Supplied Equipment
 - a. Drawings shall be provided in electronic form in both .pdf format and the drawing's native file format, (e.g. .dwg or .rvt format).
 - b. The overall dimensions of each drawing submitted to the ENGINEER shall be equal to one of the OWNER's standard sheet sizes. The title block area in the lower right-hand corner of each drawing shall be clear of all linework, dimensions, details, and notes, except for the CONTRACTOR's title block. The dimensions of the title block area are minimum and are measured from the edges of the drawing sheet.

DRAWING FORMAT			
Sheet Sizes Height x Width	Title Block Area Height x Width		
11" x 8-1/2"	2-1/2" x 3-3/4"		
11" x 17"	3" x 4"		
22" x 34"	3-1/2" x 8"		

- 3. Contract Record Drawings
 - a. The CONTRACTOR shall keep an up-to-date set of marked-up Contract Drawings on an OWNER-supplied set of Drawings.
 - b. The OWNER-supplied set of Drawings will consist of one set of full-size reproductions of the Contract Drawings, supplied to the CONTRACTOR at the start of the work.
 - c. During the progress of the work, the CONTRACTOR shall record on the Contract Record Drawings any changes from or additions to the work described in the Plans and Specifications.
 - d. All information recorded on the Contract Record Drawings shall be clearly legible.
 - e. Information to be recorded on the Contract Record Drawings shall include, but not be limited to, the following:
 - 1) Actual routing of electrical conduits, whose routing is only indicated in general on the Drawings.
 - 2) Manhole structure locations, rim elevations, and pipe invert elevations.
 - 3) Actual alignment of all installed pipe.
 - 4) Specific details of pipe connections, and manhole structures.

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- 5) Specific details on the installation and connection of mechanical and electrical equipment.
- 6) Field dimensions where they differ from those shown on the Drawings.
- 7) Additions to and/or deletions from the work, including all contract change orders.
- 8) Other details showing as-built conditions, which are shown differently or only in general on the Drawings.
- 9) Addenda.
- 10)Location of buried features located during construction except utility service connections.
- f. It is the CONTRACTOR's responsibility to ensure that any changes, deletions, specific construction details, etc., performed by a Subcontractor are recorded on the Contract Record Drawings.
- g. Location Survey:
 - 1) The CONTRACTOR shall professionally survey the lateral and vertical position of anything buried underground as part of this Contract to within one inch accuracy of the benchmark and baseline provided by the OWNER.
 - 2) The survey information shall be included on the record drawings and the CONTRACTOR shall not be allowed to cover the buried materials until after the OWNER's inspector has verified the information as accurate and complete and is shown on the record drawings.
- h. Once every month, starting from the completion of mobilization as defined in Section 01 71 13, Mobilization, the CONTRACTOR shall provide the OWNER with a copy of the then up-to-date set of marked-up Contract Record Drawings in accordance with the provisions under Section 01 29 00, Measurement and Payment, and Section 01 32 13, Progress Schedule.
- i. At the end of the work, prior to Project Closeout, the CONTRACTOR shall provide the OWNER with the Contract Record Drawings, showing all "as-built" conditions.
- j. See also Section 01 77 00, Operational Completion and Project Closeout and Section 01 74 23, Cleaning.
- I. Operation and Maintenance (O&M) Manuals:
 - 1. The CONTRACTOR shall furnish one (1) hard-copy (final approved version only) and two (2) electronic copies on USB drives of a complete instruction manual for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment or system.
 - 2. The term "Operation and Maintenance Manual" includes all product related information and documents which are required for preparation of the Equipment O&M Manuals, and data that is required for inclusion by current regulations of any participating government agency or as a provision of equipment warranties.
 - 3. Failure to provide the INSTALLATION, PRELIMINARY and FINAL Operational and Maintenance (O&M) Manuals as required by this section within the allocated time shall constitute a failure of the CONTRACTOR to provide Special Services in accordance with the requirements of the Contract. The CONTRACTOR shall be assessed Liquidated Damages in accordance with Article 5 of the Agreement until Manuals have been received. Required Delivery for O&M Manuals are as follows:
 - a. A DRAFT plan of operation containing a schedule summarizing appropriate times for essential actions to be taken for facility operation must be submitted to the Division of Water Quality at initiation of construction and approved in final form prior to 50% of construction completion. As a minimum, the plan of operation must include provisions for an operation and maintenance manual, emergency

operation and response plan, properly trained management, adequate number and training of operation and maintenance personnel, budget plan for operation and maintenance, operation reports, and start-up procedures.

- b. INSTALLATION Manuals are due 30 days before the Goods are delivered to the Point of Destination.
- c. DRAFT O&M Manuals that provide long-term guidance for efficient facility operation and maintenance must be submitted and approved prior to 50% completion.
- d. FINAL O&M Manuals are due 30 days after the completion of Acceptance Testing and submitted and approved in final form prior to 90% completion.
- 4. All equipment manufacturers shall be made aware of these requirements and all associated costs shall be included in the costs for furnishing the equipment or system.
- 5. O&M Submittal Review Checklist:
 - a. The CONTRACTOR shall include a completed O&M Manual Submittal Review Checklist (Section 01 33 00 CL, O&M Manual Review Checklist) with each O&M manual submittal.
 - b. The checklist shall indicate that the O&M manual as submitted complies in all respects to the contract requirements.
 - c. Any O&M manual submitted without a completed checklist will be rejected.
- 6. The manuals shall be furnished to the ENGINEER upon the delivery of the respective equipment.
- 7. No payment will be made for equipment or materials or equipment installation before the respective O&M manuals have been approved by the ENGINEER.
- 8. Each O&M manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.
- 9. Each O&M manual shall include, but not be limited to, the following:
 - a. Table of Contents
 - b. Diagrams and illustrations, including pump curves indicating operating points.
 - c. Detailed description of the function of each principal component of the system.
 - d. Performance and nameplate data.
 - e. Installation instructions.
 - f. Starting procedure
 - g. Proper adjustment procedure.
 - h. Test procedures.
 - i. Operating procedure.
 - j. Shutdown instructions.
 - k. Emergency operating instructions and troubleshooting guide.
 - I. Safety instructions.
 - m. Maintenance and overhaul instructions which shall include detailed assembly drawings with part numbers, parts list, instructions for ordering spare parts, and complete preventive maintenance instructions required to ensure satisfactory performance and longevity of the equipment.
 - n. Lubrication instructions which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.
 - o. List of electrical relay settings and control and alarm contact settings.
 - p. Electrical interconnection wiring diagram for equipment furnished, including all control and lighting systems.
 - q. Recommendations for spare parts and special tools.
 - r. Equipment specific warranty statement
 - s. Index

- 10. Manuals shall be transmitted to the ENGINEER upon delivery of the equipment and all equipment shall be serviced in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the ENGINEER prior to final acceptance of the project.
- J. Manufacturers' certificates and proper installation:
 - 1. The CONTRACTOR shall submit manufacturers' certificates of proper installation for items of equipment as specified under 01 79 00, Testing, Training and Startup.
- K. Samples and test specimens:
 - 1. Where required in the Specifications, and as determined necessary by the ENGINEER, test specimens or samples of materials, appliances, and fittings to be used or offered for use in connection with the work shall be submitted to the ENGINEER at the CONTRACTOR's expense, with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.
 - 2. All samples and test specimens shall be submitted in ample time to enable the ENGINEER to make any tests or examinations necessary, without delay to the work. The CONTRACTOR will be held responsible for any loss of time due to their neglect or failure to deliver the required samples to the ENGINEER, as specified.
 - 3. The CONTRACTOR shall submit additional samples as required by the ENGINEER to ensure equality with the original approved sample and/or for determination of Specification compliance.
 - 4. Laboratory tests and examinations that the OWNER elects to make in its own laboratory will be made at no cost to the CONTRACTOR, except that, if a sample of any material or equipment proposed for use by the CONTRACTOR fails to meet the Specifications, the cost of testing subsequent samples shall be borne by the CONTRACTOR.
 - 5. All tests required by the Specifications to be performed by an independent laboratory shall be made by a laboratory approved by the ENGINEER. Certified test results of all specified tests shall be submitted in duplicate to the ENGINEER. The samples furnished and the cost for the laboratory services shall be at the expense of the CONTRACTOR and included in the prices bid for the associated work.
 - 6. Approved sample items (fixtures, hardware, etc.) may be incorporated into the work upon approval, and when no longer needed by the ENGINEER for reference.
- L. Material and equipment colors:
 - 1. The ENGINEER will provide a schedule of selected colors within 30 days after approval of materials and equipment, and after receiving samples of the manufacturers' standard colors for those items requiring OWNER's selection.
- M. Certificates of Compliance:
 - 1. A Certificate of Compliance shall be furnished for materials specified to a recognized standard or code prior to the use of any such materials in the work.
 - 2. The ENGINEER may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance.
 - 3. The certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications.

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- 4. A Certificate of Compliance shall be furnished with each lot of material delivered to the work site and the lot markings on the material and certificate shall be clearly identified.
- N. Quality Assurance
 - 1. Quality control shall conform to the requirements of Section 01 45 00, Quality Control.
 - 2. Source limitations: To the greatest extent possible for each unit of work, the CONTRACTOR shall provide products, materials, or equipment of a singular generic kind from a single source.
 - 3. Compatibility of options:
 - a. Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment already selected.
 - b. Compatibility is a basic general requirement of product/material selections.
- O. Review by ENGINEER
 - 1. After review by the ENGINEER of each of the CONTRACTOR's submissions, the material will be returned to the CONTRACTOR with actions defined as follows:
 - a. NO EXCEPTIONS TAKEN: Accepted subject to its compatibility with further submittals and additional partial submittals for portions of the work not covered in this submittal. Does not constitute approval or deletion of specified or required items not shown in the partial submittal.
 - b. MAKE CORRECTIONS NOTED: Same as 1.a., except that minor corrections as noted shall be made by the CONTRACTOR.
 - c. REVISE AND RESUBMIT: Rejected because of major inconsistencies or errors which shall be resolved or corrected by the CONTRACTOR prior to subsequent review by the ENGINEER.
 - d. REJECTED RESUBMIT: Submitted material does not conform to Plans and Specifications in major respect, e.g., wrong item, wrong size, model, capacity, or material.
 - 2. Review actions (a) and (b) above constitute acceptance by the ENGINEER of the submittal.
- P. Requests for Information
 - 1. Requests for Information about the Contract Documents shall be directed by the CONTRACTOR to the ENGINEER using a Request for Information (RFI) form as agreed to by the OWNER and the ENGINEER. Such requests shall not be transmitted directly to the ENGINEER from a Subcontractor or Supplier.
 - 2. A separate form shall be used for each specific item for which information is required. Requests for Information for more than one item using a single RFI form will be permitted only when the items are so functionally related that expediency indicates review of the group of items as a whole.
 - 3. The ENGINEER will reply to the CONTRACTOR's Request for Information as soon thereafter as practicable, not to exceed ten working days.
- Q. Construction Photographs
 - 1. Provide photographs showing the preconstruction site, construction progress, and the post-construction site.
 - 2. Format: Photographs shall be digital format

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- a. Digital photos shall be taken with a minimum 16.0 mega pixel density and provided in .jpg format.
- b. Digital photo files shall be provided on a USB drive accompanied by a text file that lists the file name, date photo was taken, and brief description of the photograph and location where the photograph was taken.
- c. Take a minimum of 50 photos of the preconstruction site and the property adjacent to the perimeter of the construction site. Particular emphasis shall be directed to structures both inside and outside the site, or as directed by OWNER.
- d. Take a minimum of 72 photos monthly showing the progress of construction. The location of these photographs shall be determined by OWNER.
- e. Take a minimum of 50 photos of the post-construction site and the property adjacent to the perimeter of the site. Particular emphasis shall be directed to structures both inside and outside the plant boundary, or as indicated by OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 33 00 CL

O&M MANUAL REVIEW CHECKLIST

SUBMITTAL NO	DATED				
SPEC. SECTION REVIEW DATE					
SUBJECT					
	MANUFA	CIURER	<u> </u>		
ACCEPTABLE	PROJECT	TITLE:			
UNACCEPTABLE	PROJECT	NO.	1	.9-002	
DICDOCTION		CEPTABL	-E?	000005050	
DISPOSITION	YES	NO	NA	COMMENTS	
Minimum three (2) conies					
 Throo_ring binder with bard_back cover 					
Cover Label and Title Page:					
Project title and Project number					
Specification section					
System/Equipment pames					
Excility					
Equipment number					
 Heavy section dividers w/numbered plastic index table 	····				
 Sections parallel equipment specifications 	5 <u> </u>				
 Pages punched for 3 ring binder (punching does not 					
obliterate data)					
 Info larger than 8-1/2 inch x11 inch folded showing 					
title block, or included in binder pockets					
 Multiple volumes labeled "Vol. 1", "Vol. 2", etc 					
 Table of contents for entire set in each binder 					
ELECTRONIC O&M MANUALS					
 Minimum two (2) copies on USB Drive 					
Full version of O&M manual in PDF format					
 Separate text and drawing files used to create PDF O&M manual 					
 Index on USB Drive as separate file titled "index" 					
USB Drive labeled					
TECHNICAL CONTENT					
 Diagrams and illustrations, including pump curves 					
 Detailed description of function of principal 					
components					

	ACCEPTABLE?		.E?	
DISPOSITION	YES	NO	NA	COMMENTS
Performance and nameplate data				
 Installation instructions 				
Starting procedure				
 Proper adjustment procedure 				
Test procedures				
Operating procedure				
Shutdown instructions				
 Emergency operating instructions & troubleshooting 				
 Safety instructions 				
 Maintenance and overhaul instructions 				
Lubrication instructions				
 List of electrical relay settings and control and alarm contact settings 				
Electrical interconnection wiring diagrams, including				
control and lighting systems				
 Recommended spare parts and special tools 				
 Project specific warranty statement 				

+ + END OF SECTION + +

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SECTION 01 42 13

REFERENCE STANDARDS AND ABBREVIATIONS

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- A. The standards referred to, except as modified, shall have full force and effect as though printed in this Specification, and shall be the latest edition or revision thereof in effect on the bid opening date, unless a particular edition or issue is indicated. Copies of these standards are not available from OWNER.
- B. ENGINEER will furnish, upon request, information as to how copies may be obtained.
- C. Abbreviations and terms, or pronouns in place of them, shall be interpreted as follows:

AAMA:	Architectural Aluminum Manufacturer's Association
AAN:	American Association of Nurserymen
AAR:	Association of American Railroads
AASHTO:	American Association of State Highway and Transportation Officials,
	Standard Specifications
AATCC:	American Association of Textile Chemists and Colorists
ACI:	American Concrete Institute, Standards
AFBMA:	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA:	American Gas Association
AGC:	Associated General Contractors
AGMA:	American Gear Manufacturer's Association
AHAM:	Association of Home Appliance Manufacturer's
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AI:	The Asphalt Institute
AIA:	American Institute of Architects
AISC:	American Institute of Steel Construction, Specification for the Design,
	Fabrication, and Erection of Structural Steel for Buildings, and the
	AISC Code of Standard Practice
AISI:	American Iron and Steel Institute
AITC:	American Institute of Timber Construction
AMCA:	Air Moving and Conditioning Association, Standards
ANS:	American Nuclear Society
ANSI:	American National Standards Institute
APA:	American Plywood Association
API:	American Petroleum Institute
APWA:	American Public Works Association, Standard Specifications for Public
	Works Construction
ASA:	Acoustical Society of America
ASAE:	American Society of Agriculture Engineers
ASCE:	American Society of Civil Engineers
ASHRAE:	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASLE:	American Society of Lubricating Engineers

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ASME:	American Society of Mechanical Engineers
ASQU:	American Society of Quality Control
ASSE:	American Society of Sanitary Engineers
ASTM:	American Society for Testing and Materials, Standards
AWG:	American Wire Gauge
AWPA:	American Wood-Preservers' Association, Standards
AWPI:	American Wood Preservers Institute
AWS:	American Welding Society
AWWA:	American Water Works Association, Standards
BBC:	Basic Building Code, Building Officials and Code Administrators International
BHMA:	Builders Hardware Manufacturer's Association
CBM:	Certified Ballast Manufacturer's
CEMA:	Conveyors Equipment Manufacturer's Association
CGA:	Compressed Gas Association
CISPI:	Cast Iron Soil Pipe Institute. Standards
CLEMI:	Chain Link Fence Manufacturer's Institute
CMAA:	Crane Manufacturers' Association of America
CMA	Concrete Masonry Association
	Concrete Reinforcing Steel Institute Standards
	Diamond Core Drill Manufacturer's Association
FIA:	Electronic Industries Association
ETI ·	Electrical Test Laboratories
EFD/OSHA	Edderal Occupational Safety and Health Administration Standards
FM·	Factory Mutual
ICBO:	International Conference of Building Officials
ICEA:	Insulated Cable Engineers Association
IEFE:	Institute of Electrical and Electronic Engineers
IEC.	Illuminating Engineering Society
	Institute of Makers of Explosives
	Institute of Petroleum (London)
	Institute of Printed Circuits
	Insulated Power Cable Engineers Association
	Instrument Society of America
15A.	International Organization of Standardization
	Institute of Traffic Engineers
MBMA:	Metal Building Manufacturer's Association
	Mechanical Dower Transmission of Association
MTT.	Marino Tocting Instituto
MCC.	Manufacturers Standardization Society
	Manufacturers Standaruization Society
	National Association of Architectural Metal Manuacturers
	National Association of Corrosion Engineers, Standards
	National Committee for Clinical Laboratory Chardenda
	National Committee for Cinical Laboratory Standards
NEC:	National Electric Code
NEMA:	National Electrical Manufacturers' Association, Standards
NFPA:	
NFPA:	National Forest Products Association
NLGI:	National Lubricating Grease Institute
NMA:	National Microfilm Association

NWMA:	National Woodwork Manufacturers Association
OSHA:	Occupational Safety and Health Administration
PCA:	Portland Cement Association
PCI:	Prestressed Concrete Institute
RIS:	Redwood Inspection Service, Standard Specifications
RVIA:	Recreational Vehicle Industry Association
RWMA:	Resistance Welder Manufacturer's Association
SAE:	Society of Automotive Engineers
SAMA:	Scientific Apparatus Makers Association
SDI:	Steel Door Institute
SIS:	Swedish Standards Association
SMA:	Screen Manufacturer's Association
SMACNA:	Sheet Metal and Air Conditioning Contractors National Association
SPR:	Simplified Practice Recommendation
SSBC:	Southern Standard Building Code, Southern Building Code Congress
SSPC:	Steel Structures Painting Council, Specifications
SSPWC:	Standard Specifications for Public Works Construction
TAPPI:	Technical Association of the Pulp and Paper Industry
TFI:	The Fertilizer Institute
UBC:	Uniform Building Code of the International Conference of Building
	Officials
UPC:	Uniform Plumbing Code
UL:	Underwriters Laboratories
WCLA:	West Coast Lumbermen's Association, Standard Grading and Dressing
	Rules
WCLIB:	West Coast Lumber Inspection Bureau
WCRSI:	Western Concrete Reinforcing Steel Institute
WRI:	Wire Reinforcement Institute, Inc.
WWPA:	Western Wood Products Association

1.2 OTHER ABBREVIATIONS

A. Other common abbreviations that may be found in the Specifications are, but may not be limited to:

		company	Со
acrylonitrile butadiene	ABS	cubic inch	cu in, in ³
styrene		cubic foot	cu ft, CF, ft³
alternating current	a-c, AC	cubic yard	cu yd, CY, yd³
American wire gauge	AWG	cubic feet per minute	cfm, ft³/min
ante meridiem	am	cubic feet per second	cfs, ft³/s
ampere	A, amp		
average	avg	decibel	dB
		decibels, A-weighted	dBA
biochemical oxygen	BOD	degree Centigrade (Ce	lsius) °C, C
demand		degree Fahrenheit	°F, F
brake horsepower	bhp	diameter	diam, ø
British thermal unit	BTU	direct current	d-c, DC
		dollars	\$
Centigrade	С	ductile iron	DI
chlorinated polyvinyl	CPVC		
chloride		each	ea, @

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efficiency	eff	maximum	max
elevation	El., Elev	mean sea level	MSL
ethylene proplylene rubbe	er EPDM	mercury	Hg
exhaust fan	EF	miles per hour	mph
	_	milli-amp	mA
Fahrenheit	F	milliampere DC	mAdc
feet	ft	milligram	mg
feet per hour	fph, ft/h	milligrams per liter	mg/l
feet per minute	fpm, ft/min	milliliter	ml
feet per second	fps, ft/s	millimeter	mm
fiberglass reinforced	FRP	million gallon	mil
plastic		million gallons per day	mgd
figure	Fig.	minimum	min
flange	flg	motor control center	MCC
foot-pound	ft-lb		
		net positive suction	
gallon	gal	head available	NPSHA
gallons per hour	gph, gal/hr	net positive suction	
gallons per minute	gpm, gal/min	head required	NPSHR
gallons per second	gps, gal/s	number	No., #
gram	g	National Pipe Thread	NPT
ground fault current	GFCI		
interrupter		Operation and Maintenance	O&M
		ounce	oz
hand/off/automatic	HOA	outside diameter	OD
heating, ventilating, and	HVAC		
air conditioning		parts per million	ppm
Hertz	Hz	post meridiem	pm
hour	hr	plus or minus	+/-, ±
horsepower	hp	polytetrafluorethylene	PTFE
-	-	polyvinyl chloride	PVC
inch	in	pound	lb
inch-pound	in-lb	pounds per square foot	psf, lb/ft ²
input/output	I/O	pounds per square inch	psi, lb/in ²
inside diameter	ID	pounds per square inch	• • •
instrumentation and	I&C	absolute	psia
control		pounds per square inch	
		gage	psig
kilovolt	kV	Process and Instrumentation	י ג ו
kilovolt-ampere	kVA	Diagrams	P&ID
kilowatt	kW	2	
kilowatt-hour	kWhr	random access memory	RAM
		reinforced concrete pipe	RCP
length	L	reinforced concrete cylinder	
length to least radius	L/r	, pipe	RCCP
of gyration	,	relative humidity	RH
liaht emittina diode	LED	revolutions per minute	rpm
linear	lin	- F	1-
linear foot	lin ft	second	sec, s
liter	1	specific gravity	sp ar
		square foot	g ft, SF, ft ²
manhole	MH	square inch	sq in, in ²
		-	

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Provo City Provo City Water Reclamation Facility

square yard stainless steel standard standard cubic feet	sq yd, SY, yd ² SS std
per minute symmetrical	scfm sym.
total dynamic head totally-enclosed, fan-	tdh
cooled	TEFC
totally-enclosed, non- ventilated twisted shielded	TENV TWSH
ultraviolet United States	UV US, USA
variable frequency drive volt	VFD, AFD V
volts alternating current volts direct current	VAC VDC
water to cement water column	W/C, wc W.C.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

Provo City Provo City Water Reclamation Facility

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February 2025 Construction Documents Phase 1 Electrical Refeed Packages A-E

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 OBSERVATION AND SUPERVISION

- A. The ENGINEER or ENGINEER's appointed representative will review the Work and the CONTRACTOR shall provide facilities and access to the Work at all times as required to facilitate this review.
- B. Responsibility:
 - 1. The CONTRACTOR shall be solely responsible to supervise and direct the entire Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to complete the Work in accordance with the Contract Documents.
 - 2. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, quality control, and procedures of construction and safety precautions and programs incidental thereto.
 - 3. The foregoing includes work performed by the CONTRACTOR's Subcontractors.
 - 4. The CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.
- C. Superintendent:
 - 1. The CONTRACTOR shall designate in writing and keep on the work site at all times during its progress a technically qualified, English-speaking superintendent, who shall not be replaced without written acceptance of the ENGINEER.
 - 2. The superintendent shall be the CONTRACTOR's representative at the job site and shall have authority to act on behalf of the CONTRACTOR.
 - 3. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR.
 - 4. The CONTRACTOR's superintendent shall be present at the site of the Work at all times while work is in progress. Failure to observe this requirement shall be considered as suspension of the Work by the CONTRACTOR until such time as such superintendent is again present at the site.

1.2 RESPONSIBILITY

A. The CONTRACTOR is responsible for conducting all testing and inspection specifically required by the Specifications and otherwise necessary to ensure compliance with the Contract Documents.

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- 1. Approval of Testing Laboratories:
 - a. All laboratory work under this contract shall be performed by a laboratory approved by the ENGINEER, whether the laboratory is employed by the CONTRACTOR, or is owned and operated by the CONTRACTOR.
 - b. The basis of approval includes the following:
 - 1) Testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E 329 and ASTM D 3666, respectively.

- 2) Testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive testing shall comply with ASTM E 548.
- B. The ENGINEER may conduct periodic independent testing and inspection to verify compliance with the Contract Documents.
- C. Retesting:
 - 1. The OWNER reserves the right to back-charge the CONTRACTOR for retesting of deficient or defective work or products upon written notification.
 - 2. Compensation for retesting on behalf of the OWNER will be made through deductions from the Progress Payments.
- D. The CONTRACTOR is responsible for correcting all defective work discovered prior to final acceptance of the Contract, despite the failure of the Inspector(s) to discover it.

1.3 TESTS AND INSPECTIONS

- A. The CONTRACTOR shall be responsible for scheduling all inspections and tests required.
 - 1. The ENGINEER shall be given a minimum 72 hours' notice prior to any inspections or tests.
- B. The CONTRACTOR shall pay for all tests including, but not limited to:
 - 1. Inspections and tests necessary to comply with laws, ordinances, rules, regulations and orders of public authorities pursuant to General Conditions.
 - 2. Mix designs, including tests of trial batches, on concrete mixes.
 - 3. Tests of materials, inspections, and certifications required by the Specifications.
 - 4. Testing, adjusting, and balancing of equipment and systems required by the Specifications.
 - 5. One tension and elongation test for each 5 tons of steel or fractional part thereof for each size will be required, unless the steel can be identified by heat or melt numbers and is accompanied by mill analysis and test reports. Commercial stock may be used, subject to approval of the ENGINEER.
 - 6. Any testing performed by the CONTRACTOR for their own quality control (e.g., compaction tests).
 - 7. Retests or re-inspections by the OWNER, if required, and tests or inspections required due to CONTRACTOR error or lack of required identifications of material.
 - 8. Any and all water used by the CONTRACTOR in any testing.
- C. Two copies of the agency or laboratory report of each test or inspection shall be provided to the ENGINEER. All tests of materials shall be made in accordance with the commonly recognized standards of national technical organizations, and such other special methods and tests as are prescribed in the Contract Documents.
- D. Purchase Orders:
 - 1. One copy of each of the CONTRACTOR's purchase orders for materials forming a portion of the work shall be furnished to the ENGINEER, if requested.
 - 2. Each such purchase order shall contain a statement that the materials included in the order are subject to inspection by the OWNER.
 - 3. Materials purchased locally will be inspected at the point of manufacture or supply, and materials supplied from points more than 50 miles from the job site will be

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inspected upon arrival at the job, except when other inspection requirements are provided for specific materials in other sections of this specification.

- E. Samples:
 - 1. The CONTRACTOR shall furnish samples of materials as are required by the ENGINEER, without charge.
 - 2. No material shall be used until the ENGINEER has had the opportunity to test or examine such materials.
 - 3. Samples will be secured and tested whenever necessary to determine the quality of the material.
 - 4. Samples and test specimens prepared at the job site, such as concrete test cylinders, shall be taken or prepared by the ENGINEER in the presence and with the assistance of the CONTRACTOR.

1.4 AUTHORITY AND DUTIES OF INSPECTOR

- A. Inspectors employed by the OWNER shall be authorized to inspect all work done and materials and equipment furnished to complement the CONTRACTOR furnished independent inspector.
 - 1. Such inspection may extend to all or any part of the work, and to the preparation, fabrication, or manufacture of the materials and equipment to be used.
 - 2. The Inspector will not alter or waive the provisions of the Contract Documents.
 - 3. The Inspector will keep the ENGINEER informed as to the progress of the work and the manner in which it is being done.
 - 4. The Inspector will call the CONTRACTOR's attention to nonconformance with the Contract Documents that the Inspector may have observed.
 - 5. The Inspector will not be responsible for the adequacy or correctness of the CONTRACTOR's means, methods, techniques, sequences, or procedures for construction.
 - 6. The Inspector will not approve or accept any portion of the work, issue instructions contrary to the Contract Documents, or act as foreman for the CONTRACTOR.
 - 7. The Inspector may reject defective materials, equipment, or work when it is not in compliance with the Contract Documents.
 - 8. The Inspector will not be responsible for:
 - a. The CONTRACTOR's quality control program.
 - b. The CONTRACTOR's safety program.
 - c. Coordinating the work or activities of the CONTRACTOR or their Subcontractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

<u> PART 1 - GENERAL</u>

1.1 CONTRACTOR'S STAGING AREA AND WORK ACCESS PLAN

- A. The CONTRACTOR shall limit the location of the storage of equipment and materials to the staging area(s) designated on the Drawings and as directed by the ENGINEER.
- B. The CONTRACTOR shall make their own arrangements for additional space that may be required and shall bear all associated costs.
- C. The CONTRACTOR shall submit a work access plan showing the planned access route for deliveries of supplies and mobilization of work force for ENGINEER's approval prior to mobilization.
- D. On-Site Project Office:
 - 1. The CONTRACTOR shall maintain near the work in progress a suitable office or other protected area in which shall be kept project copies of the Contract Documents, project progress records, project schedule, shop drawings and other relevant documents which shall be accessible to the OWNER and ENGINEER during normal working hours.
 - 2. The CONTRACTOR shall make their own arrangements for additional space that may be required and bear all associated costs.
- E. Temporary Facilities Plan:
 - 1. The CONTRACTOR shall submit to the ENGINEER for approval, as part of the mobilization effort, the proposed plan and layout for all temporary offices, sanitary facilities, temporary construction roads, storage buildings, storage yards, temporary water service and distribution, temporary telephone and temporary power service and distribution.
 - 2. The plan shall show all temporary fencing and gates and all proposed access to the work areas.
 - 3. Prior to the removal of existing fence, the CONTRACTOR shall provide temporary security fencing at least equal to the existing chain link and barbed wire fencing to protect the existing facilities and structures.
- F. Access Roads:
 - 1. The CONTRACTOR shall "winterize" all access roads to provide a surface reasonably satisfactory for traffic during wet winter months.
 - 2. The roads shall be gravel surfaced, even, free from humps and depressions.
 - 3. All costs of complying with this requirement shall be included in the GMP bid.

1.2 STORAGE - GENERAL

A. The CONTRACTOR shall provide any temporary storage required for the protection of equipment and materials as recommended by manufacturers of such materials.

1.3 STORAGE BUILDINGS

- A. The CONTRACTOR shall erect or provide temporary storage buildings of the various sizes as required for the protection of mechanical and electrical equipment and materials as recommended by manufacturers of such equipment and materials.
- B. The buildings shall be provided with such environmental control systems that meet recommendations of manufacturers of all equipment and materials stored in the buildings.
- C. The buildings shall be of sufficient size and so arranged or partitioned to provide security for their contents and provide ready access for inspection and inventory.
- D. At or near the completion of the work, and as directed by the ENGINEER, the temporary storage buildings shall be dismantled, removed from the site, and remain the property of the CONTRACTOR.
- E. Combustible materials (paints, solvents, fuels, etc.) shall be safely stored and separated in accordance with the manufacturer's requirements and in compliance with hazardous material storage requirements. CONTRACTOR shall be responsible for providing proper storage buildings for combustible materials.

1.4 STORAGE YARDS

- A. The CONTRACTOR shall provide temporary storage yards as required for the storage of materials that are not subject to damage by weather conditions.
- B. Materials such as pipe, reinforcing and structural steel, shall be stored on pallets or racks, off the ground, and stored in a manner to allow ready access for inspection and inventory.
- C. Temporary gravel surfacing of the storage yards shall meet with the approval of the ENGINEER.

1.5 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, OWNER's operations, or construction operations.

1.6 VEHICULAR TRAFFIC

- A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.
- B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.
- C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

1.7 DELIVERY-STORAGE-HANDLING

- A. General:
 - 1. The CONTRACTOR shall deliver, handle, and store materials and equipment in accordance with SUPPLIER's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft.
 - 2. Delivery schedules shall be controlled to minimize long-term storage at the site and overcrowding of construction spaces.
 - 3. In particular, the CONTRACTOR shall provide delivery/ installation coordination to ensure minimum holding or storage for material or equipment recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss.
- B. Transportation and Handling:
 - 1. Materials and equipment shall be transported by methods to avoid damage and shall be delivered in dry, undamaged condition in SUPPLIER's unopened containers or packaging.
 - 2. The CONTRACTOR shall provide equipment and personnel to handle the materials, and equipment by methods that will prevent soiling and damage.
 - 3. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging packaging, and surrounding surfaces.
- C. Storage and Protection:
 - 1. Materials and equipment shall be stored in accordance with SUPPLIER's written instructions, with seals and labels intact and legible. Exposed metal surfaces of valves, fittings and similar materials shall be coated with grease in accordance with manufacturer's recommendations to prevent corrosion. Sensitive materials and equipment shall be stored in weather-tight enclosures and temperature and humidity ranges shall be maintained within tolerances required by SUPPLIER's written instructions.
 - 2. For exterior storage of fabricated materials, they shall be placed on sloped support above ground. Materials or equipment subject to deterioration shall be covered with impervious sheet covering; ventilation shall be provided to avoid condensation.
 - 3. Loose granular materials shall be stored on solid surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
 - 4. Inspection:
 - a. Storage shall be arranged to provide access for inspection.
 - b. The CONTRACTOR shall periodically inspect to assure materials and equipment are undamaged and are maintained under required conditions.
 - 5. Storage shall be arranged in a manner to provide access for maintenance of stored items.

1.8 PROJECT SECURITY

A. The CONTRACTOR shall make adequate provision for the protection of the work area against fire, theft and vandalism, and for the protection of the public and OWNER personnel against exposure to injury, and for the security of any off-site storage areas.

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B. All costs for this protection shall be included within the CONTRACTOR's bid.

1.9 TEMPORARY UTILITIES

- A. The CONTRACTOR shall provide and pay for all necessary temporary telephones, fuel, power, potable water, sanitary, and proper toilet accommodations. CONTRACTOR shall not use OWNER-owned utilities.
- B. The temporary facilities to be provided by the CONTRACTOR as described above shall conform to all requirements in regard to operation, safety, and fire hazards of State and local authorities and of Underwriters.
- C. CONTRACTOR shall return the site and facilities to their original "as-found" condition, unless otherwise specified in the Contract Documents, at the completion of the project.

1.10 SOUND CONTROL

- A. The CONTRACTOR shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract.
- B. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer, so as to produce a maximum noise level of 85 dBA at 5 feet.
- C. No internal combustion engine shall be operated on the project without said muffler.
- D. Special Precautions for Inhabited Areas:
 - 1. In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation.
 - 2. In residential areas, special measures shall be taken to suppress noise generated by repair and service activities during the night hours.

1.11 DUST/AIR POLLUTION CONTROL

- A. The CONTRACTOR shall take whatever steps, procedures, or means as are required to prevent dust conditions being caused by operations in connection with the execution of the Work; and on any road which the CONTRACTOR or any of their subcontractors are using, excavation or fill areas, demolition operations, or other activities.
- B. Control shall be by sprinkling, use of dust palliatives, modification of operations, or any other means acceptable to agencies having jurisdiction.
- C. Damage to personal property, etc., resulting from the CONTRACTOR's construction operations shall be borne by the CONTRACTOR at no cost to the OWNER.
- D. The CONTRACTOR shall keep the streets and work area clean at all times by means of mechanical sweepers or hand sweeping. Water will be used for dust control only, and not for cleaning streets.
- E. Burning of waste, rubbish, or other debris will not be permitted on or adjacent to site.

1.12 WASTE DISPOSAL

- A. The CONTRACTOR shall dispose of surplus materials, waste products, and debris and shall make necessary arrangements for such disposal. The CONTRACTOR shall obtain written permission from property owner prior to disposing surplus materials, waste products, or debris on private property.
- B. All waste disposal shall be done in accordance with applicable laws and regulations.
- C. Landfill Disposal:
 - 1. If the CONTRACTOR proposes to dispose of construction debris, trench spoils, excavation spoils, etc., at a landfill, the CONTRACTOR shall be responsible to provide and pay for all permits and analyses required by the landfill.
 - 2. If the analyses determine that the material is hazardous, then an equitable adjustment of the Contract for the cost of hazardous waste disposal will be made in accordance with the General Conditions, and the following:
 - a. Time extension or contract costs will not be granted for delays that could have been avoided by the CONTRACTOR redirecting their forces and equipment to perform other work on the contract.
- D. Ditches, washes, or drainageways shall not be filled.
- E. Disposal operations shall not create unsightly or unsanitary nuisances.
- F. The CONTRACTOR shall maintain the disposal site in a condition of good appearance and safety during the construction period.
- G. Prior to final acceptance of the work, the CONTRACTOR shall have completed the leveling and cleanup of the disposal site.

1.13 CLEAN UP

- A. Throughout the period of construction, the CONTRACTOR shall keep the work site free and clean of all rubbish and debris, and shall promptly remove from the site, or from property adjacent to the site of the work, all unused and rejected materials, surplus earth, concrete, plaster, and debris.
- B. Upon completion of the work, and prior to final acceptance, the CONTRACTOR shall remove from the vicinity of the work all plant, surplus material, and equipment belonging to the CONTRACTOR or used under their direction during construction.

1.14 TEMPORARY ENCLOSURES

- A. When sandblasting, spray painting, spraying of insulation, or other activities inconveniencing or dangerous to property or the health of employees, the public or construction workers, are in progress, the area of activity shall be enclosed adequately to contain the dust, over spray, or other hazard.
- B. In the event there are no permanent enclosures of the area, or such enclosures are incomplete or inadequate, the CONTRACTOR shall provide suitable temporary enclosures as required by the ENGINEER to meet field conditions in accordance with

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the recommendations of the owner-furnished equipment SUPPLIER (if applicable) and the CONTRACTOR's equipment supplier requirements.

C. Said temporary or permanent enclosures shall be adequately ventilated to ensure the safety of the workers.

1.15 DRAINAGE

- A. The CONTRACTOR shall take all necessary actions as required to meet the requirements of Section 01 57 23, Temporary Storm Water Pollution Control, and the discharge requirements of the State of Utah and Provo City and other pertinent ordinances and regulations pertaining to dewatering and/or site drainage discharged into storm drains and creeks. This may include, but may not be limited to, the use of retention basins and silt basins to settle most of the solids prior to discharge.
- B. In excavation, fill, and grading operations, care shall be taken to disturb the preexisting drainage pattern as little as possible.
- C. Particular care shall be taken not to direct drainage water onto private property or into streets or drainageways inadequate for the increased flow.
- D. Drainage means shall be provided to protect the work.

1.16 TEMPORARY LIGHTING

A. The CONTRACTOR shall provide temporary lighting in all work areas sufficient to maintain a lighting level during working hours not less than the lighting level required by OSHA standards.

1.17 CONSTRUCTION FACILITIES

- A. Construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.
- B. Temporary supports shall be designed with an adequate safety factor to assure adequate load bearing capability. Whenever required by safety regulations, the CONTRACTOR shall submit design calculations for staging and shoring prior to application of loads.

1.18 REMOVAL OF TEMPORARY FACILITIES AND UTILITIES

- A. At such time or times as any temporary construction facilities and utilities are no longer required for the work, the CONTRACTOR shall notify the ENGINEER of their intent and schedule for removal of the temporary facilities and utilities, and obtain the ENGINEER's approval before removing the same.
- B. As approved, the CONTRACTOR shall remove the temporary facilities and utilities from the site as CONTRACTOR's property and leave the site in such condition as specified, as directed by the ENGINEER, and/or as shown on the Drawings.

C. In unfinished areas, such as planted medians, the condition of the site shall be left in a condition that will restore original drainage, evenly graded, seeded or planted as necessary, and left with an appearance equal to, or better than original.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 51 00

TEMPORARY BYPASS PUMPING

<u> PART 1 - GENERAL</u>

1.1 GENERAL

- A. Scope: This Section covers temporary bypass pumping requirements, required of the CONTRACTOR that shall apply during construction, including but not limited to furnishing all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting existing flow around the work area for the duration necessary to complete the work.
- B. The CONTRACTOR shall inform all subcontractors and manufacturers of the requirements herein and include the required services in their costs for the work specified in these Contract Documents.
- C. The design, installation and successful operation of the temporary pumping system shall be the CONTRACTOR's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- D. The bypass system shall be designed, installed and operated by the CONTRACTOR to prevent any and all leakage or discharge of the process stream to the environment. If a leak or discharge occurs, CONTRACTOR shall be solely responsible for the remedy of the leak, containment and clean-up of the discharge, as well as responsible for any direct or consequential damages, including fines, that are associated with the leak.
- E. Scheduling:
 - 1. Temporary bypass pumping is requisite to satisfactory completion of the Contract and, therefore, shall be completed within the contract time.
 - 2. All temporary bypass pumping activities shall be realistically allowed for and shown on the CONTRACTOR's Construction Schedule.
 - 3. Schedule and perform work in a manner that does not cause or contribute to overflows, releases or spills of process streams from surrounding collection systems or the bypass system.
 - 4. All temporary bypass pumping shall be scheduled in conformance with the restrictions specified in Section 01 11 00, Summary of Work.

1.2 SUBMITTALS

- A. Temporary Bypass Pumping Plan:
 - 1. Not less than 1 month prior to CONTRACTOR's intended start of temporary bypass pumping, the CONTRACTOR shall submit a detailed Temporary Bypass Pumping Plan to the ENGINEER for review.
 - 2. Temporary Bypass Pumping shall not commence without written approval of the plan from the ENGINEER.
 - 3. The Temporary Bypass Pumping Plan shall include:
 - a. Detailed description of the Temporary Bypass Pumping Plan, including a drawing identifying suction manholes, vaults, or tanks, suction piping, pumps, discharge piping, and discharge connection details.

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- b. Description of process stream plugging method and types of plugs
- c. Number, size, material, location and method of installation of suction piping
- d. Number, size, material, method of installation and location of installation of discharge piping
- e. Bypass pump information, including make, model, size, curves with operating range clearly delineated, number of each size to be on site and power requirements
- f. Description of backup pump, power and piping equipment
- g. Calculations for static lift, flow velocity, friction and fittings losses
- h. Power generator size, location, fueling plan
- i. Method of protecting discharge manholes or structures from erosion and damage
- j. Thrust and restraint block sizes and locations
- k. Where discharge into downstream manholes, vaults, or tanks is not possible, CONTRACTOR shall provide sections showing discharge pipe depth, embedment, and method of providing leakproof connection
- I. Any temporary pipe support and anchoring required
- m. Schedule for installation and maintenance of bypass pumps and piping
- n. Startup, leakage and pressure testing plan
 - 1) Testing shall be conducted using clean water
 - 2) ENGINEER shall be notified a minimum of 72 hours prior to testing.
- o. Identification of any coordination required with the OWNER's staff
- p. Plan for monitoring upstream mains for backup impacts
- q. Procedures for setup and breakdown of pumping operations
- r. System Monitoring Plan
- s. Emergency plan detailing procedures to be followed in event of pump failures, water overflows, service backups, and sewage spillage
- t. Maintain copy of emergency plan on site for duration of project

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All bypass piping shall be fusion bonded High-Density Polyethylene
- B. Discharge piping diameter: Minimum of 4-inch diameter
- C. Suction piping diameter: Determined according to pump size, flow calculations, and depth of starting vessel or manhole following manufacturer's specifications and recommendations.
- D. Polyethylene Plastic Pipe:
 - 1. High density solid wall and following ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-DR) based on Outside Diameter, ASTM D1248 and ASTM D3550
 - 2. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.
- E. High-Density Polyethylene (HDPE).
 - 1. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.
 - 2. Defective areas of pipe: Cut out and joint fused as stated herein.

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- 3. Assembled and joined at site using couplings, flanges or butt-fusion method to provide leak proof joint. Follow manufacturer's instructions and ASTM D 2657. Threaded or solvent joints and connections will not be permitted.
 - a. Fusing: By personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment.
 - b. Butt-fused joint: True alignment and uniform roll-back beads resulting from use of proper temperature and pressure.
 - c. Allow adequate cooling time before removal of pressure.
 - d. Watertight and have tensile strength equal to that of pipe.
- 4. Flexible Hoses and Associated Couplings and Connectors.
 - a. Abrasion resistant.
 - b. Suitable for intended service.
 - c. Rated for external and internal loads anticipated, including test pressure.
 - 1) External loading design: Incorporate anticipated traffic loadings, including traffic impact loading.
 - d. When subject to traffic loading, compose system, such as traffic ramps or covers.
 - 1) Install system and maintain H-20 loading requirements while in use or as directed by the ENGINEER.
- F. Valves and Fittings:
 - 1. Provide all valves and fittings necessary to operate the Bypass Pumping System and to enable quick adjustments or modifications to the system, such as pump switchout.
 - 2. Selection shall be appropriate for process stream being transferred and shall be based on flow calculations and system operating pressures.
 - 3. At minimum, the following valves shall be provided:
 - a. Check valves on the discharge of each pump
 - b. Isolation valves that enable either the duty or the standby pump to be brought online or taken offline without delay.
- G. Plugs: Selected and installed according to size of line to be plugged, pipe, manhole, vessel or vault configurations, and based on specific site.
 - 1. Plugs shall be inspected for defects prior to use
 - 2. Provide redundant plugs available in the event a plug fails
- H. Aluminum irrigation piping or glued PVC piping will not be permitted.
- I. Discharge hose will only be allowed in short sections when approved by ENGINEER.

2.2 EQUIPMENT

- A. Pumps: Provide fully automatic self-priming units that do not require foot-valves or vacuum pumps for priming.
 - 1. Leak proof design
 - 2. Capable of passing minimum 2" diameter solids
 - 3. Pumps shall have minimum 4" suction and discharge connections
 - 4. Electric or diesel powered
 - 5. Able to run dry without damage
 - 6. Provide start/stop controls for each pump, complete with visual and auditory alarming systems.

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- 7. Provide a minimum of one full capacity standby pump for each size maintained onsite. Standby pump shall be maintained online, isolated from duty pump by a valve.
- 8. Provide noise attenuation system for pumps producing noise louder than 60 dBA at 30 feet from pump.
- 9. Bypass System Capacity:
 - a. Bypass system shall have a minimum capacity equal to the peak anticipated flows at the bypass point.

PART 3 - EXECUTION

3.1 INSTALLATION AND REMOVAL

- A. Provisions and requirements must be approved by ENGINEER before implementation.
- B. OWNER and ENGINEER shall be notified of the schedule and present during installation of Bypass Pumping system.
- C. Access manholes or make connections to existing sewer and construct temporary bypass pumping structures at access location indicated on ENGINEER approved Drawings.
- D. Plugging or blocking of water flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, remove in a manner that permits the water flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- E. When working inside manhole, force main, vessel or vault, follow all OSHA, Local, State and Federal safety requirements. Take required measures to protect workforce against gases and/or combustible or oxygen-deficient atmosphere.
- F. Installation, Operation and Removal of Bypass Pipelines:
 - 1. Pipeline may be placed along shoulder of roads. Do not place in streets or sidewalks.
 - 2. When bypass pipeline crosses local streets and private driveways, place in roadway ramps.
 - 3. When roadway ramps cannot be used, place bypass in trenches and cover with temporary pavement as approved by ENGINEER.
 - 4. During bypass pumping operation, protect pipelines from damage inflicted by equipment.
 - 5. Upon completion of bypass pumping operations, and after the receipt of written permission from ENGINEER, remove piping, restore property to pre-construction condition and restore pavement. Bypass pipeline shall be flushed with potable water prior to removal to prevent spillage of sewage to the environment.

3.2 INITIAL TESTING

A. Pressure testing of the bypass pipeline shall be conducted and witnessed by the ENGINEER prior to initial testing. Pressure testing shall be with potable water. The provision of potable water for testing shall be the responsibility of the CONTRACTOR.

- B. An initial test of the complete bypass pumping system shall be conducted in the presence of the ENGINEER, using potable water. The provision of potable water for testing shall be the responsibility of the CONTRACTOR.
- C. Pumps in pumping systems requiring suction lift shall be shown to be capable of selfpriming after a loss of prime, with a minimum reprime lift greater than the suction lift that will be required during normal operation.
- D. Suction pipe configuration for reprime test shall incorporate a 2-ft minimum horizontal run, a 90° elbow, and a vertical run at the minimum specified lift. Pipe size shall be equal to the pump suction diameter.
- E. Repeatability of performance shall be demonstrated by testing three consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle. No water should be discharged from the priming system to the environment during priming or operation.

3.3 OPERATION OF THE BYPASS SYSTEM

- A. CONTRACTOR shall have sole responsibility for the operation of the bypass system. Full time monitoring shall be required unless the CONTRACTOR can show that response time to a system failure is adequate to prevent an overflow or other impact to the operations, and an adequate monitoring and alarm system is provided. Neither OWNER nor ENGINEER personnel shall be involved in bypass system operation in any way.
 - 1. Part time monitoring:
 - a. CONTRACTOR shall be responsible for monitoring bypass pumping operations during work hours using CONTRACTOR personnel who are on site performing other functions. Bypass pumping operations shall be monitored, including examination of the entire length of the bypass pipeline, at least three times per day during work hours to confirm that all systems are fully functional, not leaking, and in good condition.
 - b. When bypass pumping is utilized full time (24 hours per day), CONTRACTOR shall provide a means of remotely monitoring Bypass Pumping operation and shall have personnel on standby to address any malfunction.
 - 2. Full time monitoring:
 - a. CONTRACTOR shall supply personnel dedicated to the monitoring and maintenance of the bypass system full time during all hours that the system is operated (24 hours per day).

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SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

<u> PART 1 - GENERAL</u>

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials and resources to fully comply with applicable Local, State and Federal regulations and requirements for water pollution prevention and control.

1.2 PROJECT PERMITS

- A. The CONTRACTOR shall comply with the terms of the following permits and documents for this Project:
 - 1. State of Utah, National Pollution Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities.
 - 2. CONTRACTOR shall obtain project specific UPDES construction permit issued by the State Water Resources Control Board and have a WDID#.
 - 3. CONTRACTOR shall prepare Storm Water Pollution Prevention Plan (SWPPP) specifically for this project in compliance with Provo City, Utah County, and State of Utah requirements for Stormwater Discharges Associated with Construction and Land Disturbance Activities. CONTRACTOR shall comply with all SWPPP requirements for the project. CONTRACTOR shall complete applicable water pollution control work as directed by the project Qualified SWPPP Practitioner (QSP).
- B. Dewatering:
 - 1. If the CONTRACTOR proposes to dispose of construction dewatering water such that it will reach a surface water (i.e. the Utah Lake), the CONTRACTOR shall obtain permits as required by law for this activity:
 - a. Obtain coverage under General NPDES Permit Waste Discharge Requirements for Low Threat Discharges to Surface Waters.
 - 1) As required by general NPDES Permit, the CONTRACTOR shall evaluate potential alternatives to disposing of construction dewatering water to a surface water, including but not limited to discharge to a municipal wastewater treatment plant, land disposal/reclamation, reuse (i.e. dust control), etc.
 - 2) The CONTRACTOR shall be responsible for preparing and submitting the required permit application documents and paying all applicable permit fees for coverage under General NPDES Permit.
 - 3) The CONTRACTOR shall be responsible for developing the required Best Management Practices for this permit to manage discharges to surface waters. CONTRACTOR shall contact the Legally Responsible Person (LRP) or OWNER, the project QSP and the project Qualified SWPPP Developer (QSD) for the preparation of this amendment.
 - 4) The CONTRACTOR shall build the required permit review, approval, and public comment time for this permit into the Construction Schedule.

- 2. If the CONTRACTOR proposes to dispose of construction dewatering water by a method of land application, the CONTRACTOR shall develop a Dewatering Land Application Control Plan, which provides the following details, at a minimum:
 - a. A site map, including one-foot contours, of the area where dewatering water will be land applied.
 - 1) The map shall include an identification of all drainage features within 250 feet of the application area.
 - b. A description of anticipated dewatering water application rates, and corresponding infiltration and evaporation rates to show that no runoff is generated by the land application activity.
 - c. An estimate of daily and total water volumes to be applied for the project.
 - d. The time schedule for land application activities.
 - e. A description and schematic detailing the controls to be put in place to prevent runoff from the land application area.
 - f. CONTRACTOR shall contact the LRP or OWNER, QSP and QSD for the preparation of this amendment.

1.3 SUBMITTALS

- A. BMPs:
 - 1. CONTRACTOR shall use BMP materials as per project SWPPP and provide submittals to the ENGINEER as required per Section 01 33 00, Submittal Procedures.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. BMPs:
 - 1. Product delivery storage and handling shall in accordance with the provisions of Section 01 66 10, Product Storage, Handling, and Delivery, shall follow the project SWPPP, and shall be in accordance with all manufacturer requirements.

1.5 REGULATORY REQUIREMENTS

- A. Laws, Regulations and Permits:
 - 1. The CONTRACTOR is responsible for complying with the Clean Water Act Section 402, the NPDES General Permit for Stormwater Discharges Associated with Construction Activity, the project SWPPP, and all permits applicable to this Project, for all anticipated construction activities.
 - 2. Perform construction operations to comply, and ensure subcontractors comply, with applicable Federal, State, and Local laws, orders, regulations and water quality standards concerning control and abatement of water pollution, and terms and conditions of applicable permits and the SWPPP. If conflict occurs between Federal, State, and Local laws, regulations, and requirements, the most stringent shall apply.
 - 3. The CONTRACTOR shall know and fully comply with applicable provisions of the Permits and all modifications thereto, and Federal, State, and Local regulations and requirements that govern the CONTRACTOR's operations and stormwater and non-stormwater discharges from both the project site and areas of disturbance outside the Project Limits during construction.
 - 4. The Permits shall apply to stormwater and certain permitted non-stormwater discharges from areas outside the project site which are directly related to construction activities for this Contract including, but not limited to, material borrow areas, concrete plants, staging areas, storage yards and access roads. The

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CONTRACTOR shall comply with the Permits for those areas and shall implement, inspect and maintain the required water pollution control practices. Installing, inspecting and maintaining water pollution control practices on areas outside the Project Limits not specifically arranged for by the OWNER for the execution of this Contract will not be paid for.

- B. Contractor Violations:
 - 1. If noncompliance occurs, immediately (verbally) report noncompliance to the ENGINEER. Submit specific information within 2 days. This requirement is in addition to all violation reporting requirements for applicable project permits.
 - Consistent violations of applicable Federal, State, or Local laws, orders, regulations, or Water Quality Standards may result in the ENGINEER stopping all site activity until compliance is ensured.
 - 3. The CONTRACTOR shall not be entitled to extension of time, claim for damage, or additional compensation by reason of such a work stoppage.
 - 4. Corrective measures required to bring activities into compliance, or fines imposed by a regulating authority, which are a result of the CONTRACTOR's errors and/or negligence shall be at the CONTRACTOR's expense.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Silt fence, support fence, posts in accordance with ASTM 6461.

2.2 STRAW BALES

- A. Average dry weight not less than 50 pounds each.
- B. Bind with biodegradable ties.
- C. Certified weed and seed free.

PART 3 - EXECUTION

3.1 SWPPP IMPLEMENTATION:

- A. The CONTRACTOR shall fully implement the BMPs prescribed in the Project SWPPP. The CONTRACTOR shall be responsible in implementing all of the requirements in the Project SWPPP. If CONTRACTOR fails to meet all requirements prescribed in the Project SWPPP, the OWNER may choose to retain 20% of the total contract amount until satisfied with the Work.
- B. CONTRACTOR shall retain and submit all records and data as required by the SWPPP for mandated time period to the OWNER.
- C. Maintain copies of the NPDES General Permit for Stormwater Discharges Associated with Construction Activity and SWPPP at the project site and make permits and SWPPP available during construction.

3.2 DEWATERING OPERATIONS:

- A. The CONTRACTOR shall appropriately manage dewatering operations in compliance with all permits obtained for the Project or approved Control Plans applicable to this activity.
- B. The CONTRACTOR shall also implement any Monitoring and Reporting Programs as required by applicable permits.
- C. CONTRACTOR shall prepare a dewatering plan and submit to the ENGINEER for acceptance. See Section 31 23 19, Dewatering.

3.3 ENVIRONMENTAL REQUIREMENTS AND POLLUTION CONTROLS

- A. Prior to working within 100 feet of a waterbody, closely examine excavation equipment for oil and fuel leaks.
- B. At least on a daily basis, check and maintain equipment operated within or adjacent to a waterbody to prevent leaks of materials that if introduced to water could be harmful to aquatic life.
- C. Petroleum products and other substances which could be hazardous to aquatic life, resulting from project related activities shall be prevented from contaminating the soil and entering a water body. Do not store any of these materials at locations subject to inundation by high river or creek flows.
- D. Immediately notify the Utah Department of Fish and Game of any spills. Consult with Utah Department of Fish and Game regarding clean-up procedures.
- E. Staging, storage, and parking areas for equipment, materials, fuels, lubricants and solvents shall be located, a minimum of 50 feet horizontally from the edge of live streams, and at an elevation high enough to prevent damage or inundation during flood events.

3.4 SEDIMENT AND EROSION CONTROLS

A. Execute all methods and measures for controlling sediment and erosion as specified in the Project SWPPP.

3.5 WASTEWATER AND STORMWATER MANAGEMENT CONTROLS

- A. Execute all methods and measures to control stormwater runoff and discharges from the site that will prevent silting and erosion as specified in the Project SWPPP.
- B. Prevent wastewater from general construction activities such as drain water collection or other construction operations, from entering flowing or dry watercourses without the use of approved turbidity control methods as specified in the Project SWPPP.
- C. Divert stormwater runoff from upslope areas away from disturbed areas.

3.6 TURBIDITY CONTROL MEASURES

A. Prevent excess turbidity from entering flowing waters by using the methods and measures specified in the Project SWPPP.

3.7 CONSTRUCTION SITE MANAGEMENT

- A. CONTRACTOR Construction Operations:
 - 1. Perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes into streams, flowing or dry watercourses, wetlands, or underground water sources.
 - 2. Pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.
 - 3. Discharge of cement fines, drilling fluids, contaminated water, and other construction byproducts will not be allowed on site.
- B. Stockpiled or Deposited Materials:
 - 1. Do not stockpile or deposit excavated materials or other construction materials, near or on, stream banks or other watercourse perimeters where they can be washed away by high water or storm runoff or can in any way encroach upon the watercourse.
- C. Oil Storage Tanks Management:
 - 1. Manage in accordance with the Project SWPPP and applicable local, state and federal requirements.
 - 2. Place oil or other petroleum product storage tanks away from the project site.
 - 3. Do not use underground storage tanks.
- D. Vehicle Parking:
 - 1. Vehicles shall be stored greater than 50 ft from the edge of any waterbody at the end of each work-shift except as noted below.
 - 2. Vehicles stored less than 50 ft from a waterbody shall be parked on impermeable liner at least 10 mils thick buried under 2 to 4 inches of soil.

3.8 REMOVAL

A. Remove temporary works in accordance with Section 01 74 23, Cleaning.

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Provo City Provo City Water Reclamation Facility

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February 2025 Construction Documents Phase 1 Electrical Refeed Packages A-E

SECTION 01 58 00

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and install signs, placards, and labels for safety equipment, hazards, and equipment and piping identification.

1.2 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Shop Drawings:
 - 1. Provide manufacturer's literature showing available letter sizes and styles, standard and custom colors, and standard mounting details.
 - 2. Provide drawings showing layouts, actual letter sizes and styles, colors, and project-specific mounting details.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS SAFETY SIGNAGE

- A. Safety signs shall comply with the following standards:
 - 1. Occupational Safety and Health Administration (OSHA), Standards for General Industry, Subparts 1910.200 Hazard Communication (July, 1986)
 - 2. National Fire Protection Association (NFPA) Standard No. 704 Label System
 - 3. Uniform Fire Code, Latest Edition
 - 4. Uniform Fire Code Standard 79-3
- B. Safety signs shall be of height and width required by layout and shall be formed from semi-rigid butyrate, polyethylene or fiberglass. Lettering shall be 3-inches high and 1/2-inch in stroke.
- C. Provide safety signs in accordance with the drawings and list in Section 01 58 00 SC, Identification Devices Schedule.

2.2 IDENTIFICATION LABELS

- A. Pipe Labels and Flow Direction Arrows:
 - 1. Label, Lettering Color, Size and Placement: In accordance with ANSI A13.1, and as listed below.
 - 2. Process pipe color and label requirements per Section 40 05 10 PS, Pipe Schedule.

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3. Label Colors:

4. Label Size:

Outside Diameter of Pipe Covering, inches	Length of Color Field, inches	Size of Letters, inches
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

- 5. Label Placement:
 - a. Labels shall be positioned on the pipes so they can be easily read. Proper label placement is on the lower side of the pipe if the employee has to look up to the pipe, on the upper side of the pipe if the employee has to look down towards the pipe, or directly facing the employee if on the same level as the pipe. Labels should be located near valves, branches, where a change in direction occurs, on entry/re-entry points through walls or floors, and on straight segments with spacing between labels that allows for easy identification.
- 6. Material: Manufacture from or encase in outdoor grade plastic or vinyl that will resist damage or fading from washdown, sunlight, mildly corrosive atmosphere, dirt, grease, and abrasion.
- 7. Message: Matching "Description" per Section 40 05 10 PS, Pipe Schedule.
- 8. Labels:
 - a. Snap-Around Type: Size for finished outside diameter of pipe and insulation.
 - b. For 6 Inches and Over Diameter Pipe: May furnish strap-on type fastened without use of tools with plastic or stainless steel straps.
 - c. Firmly grip pipe so labels remain fixed in vertical pipe runs.
- 9. Manufacturers and Products:
 - a. T & B/Westline, Rariton, NJ, Model WSS Snap-Around
 - b. Seton Name Plate Corp., New Haven, CT, Setmark Series
 - c. Or equal
- B. Valve and Equipment Labels:
 - 1. Applies to valves and equipment with assigned tag numbers wherever specified.
 - 2. Lettering: Black bold face, 3/4-inch minimum high.
 - 3. Background: OSHA safety yellow.
 - 4. Materials: Either of the following:
 - a. Aluminum or stainless steel base with a baked-on finish that is suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
 - b. Fiberglass with fiberglass-encased lettering.
 - 5. Furnish 1-inch margin on each end of label for mounting. On fiberglass labels furnish grommets at each end for mounting.
 - 6. Size:
 - a. As appropriate for lettering provided.
 - b. Provide same-size labels for equipment series which are adjacent.
 - 7. Message: Equipment names and tag numbers as used in Sections where equipment is specified and/or on Drawings.
 - 8. Manufacturers and Products:
 - a. T & B/Westline Co., Rariton, NJ; Type KQ
 - b. Seton Name Plate Corp., New Haven, CT; Style EB
 - c. Or equal

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PART 3 - EXECUTION

3.1 INSTALLATION OF SIGNS

- A. Install Fire Extinguisher location signs at all fire extinguisher locations, approximately 12" above fire extinguisher mounting bracket.
- B. Install Exit Signs mounted to each door which leads to the outside of the building, on the panic bar side of the door, mounted to the door approximately 5'-6" above finished floor.
- C. Install all other signs at locations as shown on the drawings. Signs should be installed approximately 5'-6" off of finished floor, attached to doors where appropriate. Where two signs are indicated in the same location, signs should be mounted side-by-side, where possible.
- D. Install all signs plumb and level. They shall be attached with four stainless steel screws or anchor bolts as required for substrate. Provide theft/tamper-resistant fasteners on all signs.

3.2 INSTALLATION OF PIPE IDENTIFICATION LABELS

- A. Provide pipe identification label with flow arrows on all exposed piping systems as follows:
 - 1. At all connections to equipment, valves, tees or wall penetrations.
 - 2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
- B. Install pipe identification labels after all painting has been completed.

3.3 INSTALLATION OF EQUIPMENT IDENTIFICATION LABELS

- A. Install equipment identification labels on all equipment and valves which have been given a tag number in the Drawings or Specifications. Provide identification label which includes equipment name and tag number.
- B. Where no damage will be caused to equipment, mount equipment identification label directly to equipment. Otherwise, mount equipment identification labels to concrete equipment base or wall space. Install equipment identification label such that it is clear which piece of equipment is being labeled.
- C. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

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SECTION 01 61 00

GENERAL PRODUCT REQUIREMENTS

<u> PART 1 - GENERAL</u>

1.1 SCOPE

A. All products furnished and installed under this Contract shall conform to the general stipulations set forth in this Section except as otherwise specified in other Sections.

1.2 COORDINATION

A. The Equipment Supplier shall coordinate all details of the products and equipment with other related parts of the work, including verification that all structures, piping, wiring, and equipment components are compatible. Equipment Supplier shall be responsible for all structural and other alterations in the work required to accommodate products or equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.3 DESIGN REQUIREMENTS

A. Where Equipment Supplier design is specified, design and installation of systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions in the references and requirements listed in the tables below:

Design Codes and Standards
2018 International Building Code
2018 International Mechanical Code
2018 International Plumbing Code
2018 International Fire Code
2017 National Electrical Code
ACI 318-14 Building Code Requirements for Structural Concrete
ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures
ACI 350.3-06 Seismic Design of Liquid-Containing Concrete Structures
ADM1-2015 Aluminum Design Manual: Part 1 – A Specification for Aluminum
Structures
AISC 341-16 Seismic Provisions for Structural Steel Buildings
AISC 360-16 Specification for Structural Steel Buildings
AISI S100-16 North American Specification for the Design of Cold-Formed Steel
Structural Members
ASCE 7-16 Minimum Design Loads for Buildings and Other Structures
AWS D1.1 2015 Structural Welding Code Steel
AWS D1.2 2014 Structural Welding Code Aluminum
AWS D1.6 0217 Structural Welding Code Stainless Steel
ICC A117.1-09 Accessible and Usable Buildings and Facilities
OSHA Title 8, Division 4, Subchapter 7, General Safety Orders
SDI RD-2017 Standard for Steel Roof Deck
SJI 100-15 Standard Specification for Open Web Steel Joists
TMS 402-2016 Building Code for Masonry Structures

Structural Loading Criteria	
Risk Category = III for Wastewater Treatment Facilities	
 Roof Load Roof Live Load = 20 psf Roof Snow Load = Calculated based on ground snow load and ASCE 7-16 factors 	
Snow Load Ground Snow Load = 43 psf Exposure Factor, $C_e = 1.0$ Thermal Factor, C_t = Facility specific Importance Factor, $I_s = 1.10$ Floor Live Load Light manufacturing = 125 psf Heavy manufacturing = 250 psf Stairs and Exits = 100 psf Catwalks for maintenance = 40 psf HI-93 for vehicle traffic areas	
Wind Load Basic Wind Speed = 109 mph (ASCE 7-16) Exposure Category = C Seismic Load Importance Factor, I_e = 1.25 Site Class = F 	
 Mapped Spectral Response S_s = 1.413 Mapped Spectral Response S₁ = 0.525 Risk Targeted Design Spectral Response PGA = 0.568 Risk Targeted Design Spectral Response S_{DS} = 0.889 Risk Targeted Design Spectral Response S_{D1} = 0.864 Seismic Design Category = D 	

- B. Proof of Compliance
 - 1. Structural integrity and anchorage shall be certified by an approved calculation that demonstrates the adequacy of the anchorage system for seismic forces. This calculation may be based on principles of structural analysis and engineering mechanics or based on similarity to approved shake-table tests.
 - 2. Equipment Supplier shall submit for review and approval test data or calculations certified by a Civil or Structural Engineer registered in the State of Utah to show compliance with the above requirements.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 4,500 feet above mean sea level.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of -10 degrees F to 110 degrees F.

1.5 WORKMANSHIP AND MATERIALS

- A. Equipment Supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.
- B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.
- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.
- D. Except where otherwise specified, all metal which will be exposed to weather, submerged or otherwise exposed to moisture shall be either non-ferrous or stainless steel, as the application may require.

1.6 LUBRICATION

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
- B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
- C. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

1.7 DRIVE UNITS

- A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hours continuous service.
- B. Unless otherwise specified, the use of gearmotors will not be acceptable.
- C. Gear reducers
 - 1. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated antifriction, rolling element bearings throughout.

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- Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.
- 3. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.
- 4. Bearings
 - a. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun.
 - b. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent over-greasing of the bearing.
 - c. The use of permanently sealed grease lubricated bearings will not be acceptable.
 - d. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings.
 - e. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
- 5. Gear reducers that require the removal of parts or periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.
- 6. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.
- D. V-belt drives
 - 1. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate horsepower of the drive motor.

1.8 SAFETY GUARDS

- A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard.
- B. Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or 1/2-inch mesh galvanized expanded metal.
- C. Each guard shall be designed for easy installation and removal.
- D. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized.
- E. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

1.9 ANCHOR BOLTS

A. Equipment Suppliers shall furnish suitable anchor bolts for each item of equipment.

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- B. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.
- C. Anchor bolts shall comply with Section 05 05 19, Anchors, Inserts and Dowels, and shall have a minimum diameter of 1/2-inch unless otherwise specified.
- D. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

1.10 EQUIPMENT BASES

- A. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high.
- B. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment.
- C. Each unit and its drive assembly shall be supported on a single baseplate of neat design.
- D. Baseplates shall have pads for anchoring all components and adequate grout holes.
- E. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection.
- F. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03 60 00, Grout.

1.11 SPECIAL TOOLS AND ACCESSORIES

A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

1.12 SHOP PAINTING

- A. Surface Protection
 - 1. All ferrous metal surfaces shall be protected by suitable paint or coatings applied in the shop.
 - 2. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment.
 - 3. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting.
 - 4. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil-resistant enamel suitable for coating in the field with an alkyd enamel.
 - 5. Coatings shall be suitable for the environment where the equipment is installed.
- B. Shop Primer

- 1. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.
- 2. Unless otherwise specified, the shop primer for steel and iron surfaces shall be
 - a. Cook "391-N-167 Barrier Coat"
 - b. Koppers "No. 10 Inhibitive Primer"
 - c. Tnemec "37H Chem-Prime HS"
 - d. Valspar "13-R-28 Chromox Primer"
 - e. Or equal.
- C. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound:
 - 1. Houghton "Rust Veto 344"
 - 2. Rust-Oleum "R-9"
 - 3. Or equal.

1.13 PREPARATION FOR SHIPMENT

- A. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of ENGINEER.
- C. Grease and lubricating oil shall be applied to all bearings and similar items.
- D. Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the shop drawings. Complete packing lists and bills of material shall be included with each shipment.

1.14 STORAGE

- A. Upon delivery, all equipment and material shall immediately be stored and protected in accordance with Section 01 66 10, Product Storage, Handling, and Delivery, until installed in the work.
- B. At a minimum, all equipment will be stored per manufacturer's storage recommendation.
- C. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60° F. Equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.
- D. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the work.

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1.15 INSTALLATION AND OPERATION

- A. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of CONTRACTOR or their Subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.
- B. Qualified field representatives shall be provided by the equipment manufacturers as required by Section 01 79 00, Testing, Training, and Startup.
- C. All equipment installed under this Contract, including that furnished by Owner shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.
- D. Acceptance of work in connection with the installation of equipment furnished by Equipment Supplier will be subject to approval of the field representative. CONTRACTOR shall be responsible for planning, supervising, and executing the installation of work, and the approval or acceptance of ENGINEER or the field representative will not relieve CONTRACTOR of responsibility for defective work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 66 00

TRANSPORTATION AND HANDLING OF GOODS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Description of Work
 - 1. The SUPPLIER shall make all arrangements for transportation and delivery of equipment and materials to the Point of Destination.
 - 2. Shipments of materials shall be delivered to the Point of Destination only during regular working hours. Shipments shall be addressed and delivered to CONTRACTOR, except where otherwise directed.

1.2 SUBMITTALS

- A. Shipping List
 - 1. Prior to the delivery of the Goods, the SUPPLIER shall develop and submit to CONTRACTOR a Bill of Materials for the contents of all shipments. This list shall detail contents, size, weights and tag numbers of each item shipped. Upon receipt of the Goods, the Bill of Materials shall be used to determine that the Goods have been received by CONTRACTOR in accordance with the General Conditions of the Agreement.

1.3 PRODUCT DELIVERY STORAGE AND HANDLING

- A. The SUPPLIER shall arrange deliveries of products in accordance with the Contract Time requirements stipulated in the Agreement.
- B. The SUPPLIER shall coordinate deliveries that occur between specified Contract Times to accommodate the following:
 - 1. Work of other contractors or OWNER
 - 2. Limitations of storage space
 - 3. Availability of equipment and personnel for handling products
- C. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment to simplify accumulation of parts and facilitate assembly.
- D. Each part within a shipment shall be clearly labeled with the reference numbers and tag numbers included in the Bill of Materials.
- E. Upon delivery, the SUPPLIER and CONTRACTOR, shall inspect shipment(s) to ensure:
 - 1. Product complies with requirements of approved submittals
 - 2. Containers and packages are intact
 - 3. Labels are legible
 - 4. Products are properly protected and undamaged
- F. CONTRACTOR will provide equipment and personnel necessary to handle products by methods designed to prevent soiling or damage.

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G. CONTRACTOR will provide storage facilities in accordance with the SUPPLIER storage requirements to be submitted prior to delivery and along with the delivered equipment under Section 01 66 10, Product Storage, Handling, and Delivery.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +
SECTION 01 66 10

PRODUCT STORAGE HANDLING AND DELIVERY

<u> PART 1 - PART 1 - GENERAL</u>

1.1 DESCRIPTION

- A. Description of Work
 - 1. SUPPLIER shall protect goods in accordance with manufacturer recommendations and the requirements of the Contract Documents.
 - 2. SUPPLIER shall make all arrangements and provisions necessary for the protection of goods during delivery to the Point of Destination.
 - 3. Manufacturer containers may be opened for inspection and verification of the goods in accordance with Article 8 of the General Conditions. Upon completion of inspection, the goods shall be repackaged and remain unopened until the time of installation, unless recommended by the manufacturer or otherwise specified.
 - 4. SUPPLIER shall provide OWNER and CONTRACTOR with a list of goods that are to be delivered prior to shipment.
- B. Coordination: SUPPLIER shall coordinate with OWNER and CONTRACTOR for goods that require special protection, storage or handling

1.2 SUBMITTALS

- A. Provide submittals required by this section, at least 30 days prior to delivery of the goods.
- B. SUPPLIER shall provide CONTRACTOR with a list of pumps, motors, drives, electrical equipment, instrumentation equipment (controls, devices, panels, etc.), and other equipment having anti-friction or sleeve bearings for storage in weather tight storage facilities, such as warehouses.
- C. SUPPLIER shall provide CONTRACTOR with a list of all panels, microprocessor-based equipment, and all other goods and devices subject to damage or useful life decrease due to:
 - 1. Temperatures below 40 degrees F or above 120 degrees F
 - 2. Relative humidity above ninety (90) percent
 - 3. Or exposure to rain
- D. Fully Protected Storage
 - 1. SUPPLIER shall provide CONTRACTOR with a list of goods which could be damaged by low or high temperature and require temperature-controlled storage space.
 - 2. SUPPLIER shall provide CONTRACTOR a list of goods that require protection from contamination by dust, dirt, and moisture.
 - 3. The System SUPPLIER shall provide CONTRACTOR with a list of goods that require storage at specific humidity levels as recommended by manufacturer.
- E. SUPPLIER Storage and Handling Instructions

01 66 10-1

1. SUPPLIER shall provide specific storage and handling instruction for each looseshipped item of equipment, instrumentation, materials and crates provided by the System SUPPLIER.

1.3 PRODUCT STORAGE AND HANDLING

- A. Goods shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. Each container shall be clearly marked with SUPPLIER's name, project name, and location. Goods shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged prior to acceptance shall be repainted.
 - 1. All parts shall be protectively wrapped and/or packaged, using materials commensurate with the weight and configuration of the part, the method of handling, and the method of transportation.
 - 2. Contact or pressure points shall be sufficiently protected when using steel or elastic banding.
 - 3. Cabinets and equipment too heavy to be handled or transported by one man shall be adapted for handling with pallet trucks and/or forklifts.
 - 4. Painted surfaces which will come in contact with lifting forks or other handling equipment (such as the bottom of cabinets or skid base frame members) shall be sufficiently padded with heavy corrugated cardboard, foam or other protective materials.
 - 5. Small equipment and skids shall be mounted on wooden pallets designed for fork lifting. This equipment shall be bolted (using existing holes in the frame) or strapped to the pallet to prevent tipping. Equipment and skids too large to be mounted on pallets shall have wooden block bolted or strapped to the base foundation pads to prevent paint degradation during handling, assembly and installation.
- C. Electrical equipment, controls, and instrumentation shall be protected against moisture or water damage. Space heaters provided in the equipment will be connected by CONTRACTOR as noted by SUPPLIER and operated at all times until equipment is placed in operation.
- D. Notice of Enclosed Instructions: All delivered packages containing goods shall have notices clearly visible on the exterior of the package indicating that maintenance instructions are enclosed.
- E. Panel and Instrumentation Storage: All packages containing panels, electronic devices, and other microprocessor-based equipment shall contain a desiccant, volatile corrosion inhibitor (VCI) blocks, a moisture indicator, and maximum-minimum indicating thermometer. SUPPLIER shall provide a spare set of such protection equipment including a desiccant, a moisture indicator, and VCI blocks for each package containing panels, electronic devices, and other microprocessor-based equipment for replacement by CONTRACTOR during the storage period.

PART 2 - PART 2 - PRODUCTS (NOT USED)

PART 3 - PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

Provo City Provo City Water Reclamation Facility 01 66 10-3

February 2025 Construction Documents Phase 1 Electrical Refeed Packages A-E

Provo City Provo City Water Reclamation Facility

01 66 10-4

February 2025 Construction Documents Phase 1 Electrical Refeed Packages A-E

SECTION 01 71 13

MOBILIZATION

<u> PART 1 - GENERAL</u>

1.1 GENERAL

- A. Mobilization shall include the obtaining of all bonds, insurance, and licenses; moving onto the site of all plant and equipment; furnishing and erecting plants, temporary buildings, and other construction facilities; all as required for the proper performance and completion of the work.
- B. Mobilization shall include but not be limited to the following principal items:
 - 1. Moving on to the site of all CONTRACTOR's plant and equipment.
 - 2. Installing temporary construction power, wiring, and lighting facilities.
 - 3. Establishing fire protection system.
 - 4. Developing construction water supply.
 - 5. Furnishing the work access plan as specified in Section 01 50 00, Temporary Construction Facilities and Utilities.
 - 6. Providing all on-site CONTRACTOR communication facilities, including telephones, and radio pagers and any radio communications facilities required for the CONTRACTOR to coordinate their forces.
 - 7. Providing on-site sanitary facilities and potable water facilities as specified in Section 01 50 00, Temporary Construction Facilities and Utilities.
 - 8. Arranging for and erection of the CONTRACTOR's work and storage yard, including site security.
 - 9. Posting all EPA and OSHA required notices and establishment of safety programs.
 - 10. Post all required labor and EEOE notices.
 - 11. Have the CONTRACTOR's superintendent at the job site full time.
 - 12. Submittal and OWNER acceptance of the Construction Schedule.
 - 13. Establishing site security, lighting, fencing, and signing.
 - 14. Obtaining all bonds, insurance and licenses.
 - 15. Providing an organization chart of the project and for the CONTRACTOR's firm. The project chart shall include the name, title and responsibilities of each position which is involved in the work.
 - 16. Other mobilization items approved by the ENGINEER required to support the complete work (e.g., Health and Safety Plans for Hazardous Waste).

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 74 23

CLEANING

<u> PART 1 - GENERAL</u>

1.1 WORK INCLUDED

A. This section covers the work necessary for cleaning during construction and final cleaning on completion of the Work.

1.2 GENERAL

- A. At all times maintain areas covered by the Contract and public properties free from accumulations of waste, debris, and rubbish caused by construction operations.
- B. Pollution Control:
 - 1. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 2. Do not burn or bury rubbish and waste materials on project site.
 - 3. Volatile wastes shall be properly stored in covered metal containers and removed daily.
 - 4. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 5. Do not dispose of wastes into streams or waterways.
- C. Construction materials such as concrete forms and scaffolding shall be neatly stacked by the CONTRACTOR when not in use. The CONTRACTOR shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.
- D. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- E. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLEANING DURING CONSTRUCTION

- A. During execution of Work, clean site and public properties and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
- B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

- C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. Empty containers within one day after they are full.
- D. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from exposed and semi-exposed surfaces.
- E. Repair, patch, and touch up marred surfaces to specified finish to match adjacent surfaces.
- F. Vacuum clean all interior spaces, including inside cabinets. Broom clean paved surfaces, rake clean other surfaces of grounds.
- G. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- H. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.
- I. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.

3.2 FINAL CLEANING

- A. See Section 01 77 00, Operational Completion and Project Closeout, for additional requirements.
- B. At the completion of Work on all Contracts and immediately prior to final inspection, cleaning of the entire Project will be accomplished according to the following provisions:
 - 1. The CONTRACTOR shall thoroughly clean, sweep, wash, and polish all work and equipment, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
 - 2. Should the CONTRACTOR not remove rubbish or debris or not clean the building and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.
 - 3. Employ professional cleaners for final cleaning.
 - 4. In preparation for substantial completion of occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
 - 5. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces so designated to shine finish.
 - 6. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.
 - 7. Broom clean paved surfaces; rake clean other surfaces of grounds.
 - 8. Replace air-handling filters if units were operated during construction.
 - 9. Clean ducts, blowers, and coils, if air-handling units were operated without filters during construction.

- 10. Clean luminaires in accordance with manufacturer's recommendations. Clean all light fixtures.
- 11. Remove from the OWNER's property all temporary structures and all materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work. See Section 01 50 00, Temporary Construction Facilities and Utilities.

+ + END OF SECTION + +

SECTION 01 77 00

OPERATIONAL COMPLETION AND PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 GENERAL

- A. The Work will be considered operationally complete when all technical and administrative submittals, testing, training and startup are completed satisfactorily in accordance with the Contract Documents.
- B. Operational completion shall apply to the project in its entirety.

1.2 CERTIFICATION OF OPERATIONAL COMPLETION

- A. Prior to requesting the ENGINEER's inspection for certification of each phase as operationally complete, the CONTRACTOR shall certify in writing that each phase of the Work is operationally complete and shall submit a list of known items still to be completed or corrected (punchlist) prior to Contract Completion.
- B. The following items shall be completed:
 - 1. OWNER has been advised of any pending insurance changeover requirements.
 - 2. Specific warranties, maintenance agreements, final certifications and similar documents have been submitted.
 - 3. All tools, spare parts, extra stocks of materials, and similar physical items have been delivered to OWNER.
 - 4. Instruction of OWNER's operation/maintenance personnel and start up testing have been completed.
 - 5. Submittal and acceptance of all O&M manuals.
 - 6. Changeover of locks to OWNER's cores/keys.
- C. Punchlist:
 - 1. When the CONTRACTOR considers that the Work, or a portion or phase thereof which the OWNER agrees to accept separately, is operationally complete, the CONTRACTOR shall certify in writing that the work is operationally complete and shall prepare and submit to the ENGINEER a comprehensive list of items to be completed or corrected prior to Contract Completion (punchlist).
 - 2. The ENGINEER may add additional work items to the punchlist.
 - 3. Failure to include an item on the punchlist does not alter the responsibility of the CONTRACTOR to complete all Work in accordance with the Contract Documents.
 - Upon receipt of the CONTRACTOR's punchlist, the ENGINEER will make an inspection to determine whether the Work or designated portion thereof is operationally complete.
 - 5. If the ENGINEER's inspection discloses any item, whether or not included on the CONTRACTOR's list, that is not in accordance with the requirements of the Contract Documents, the CONTRACTOR shall, upon notification by the ENGINEER and before an issuance of the Certificate of Operational Completion is provided, complete or correct such item.
 - 6. The CONTRACTOR shall then submit a request for another inspection by the ENGINEER.

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- 7. When the Work or designated portion thereof is accepted by the ENGINEER to be operationally complete, the ENGINEER will prepare a Certificate of Operational Completion.
- 8. The date of Operational Completion shall be the date of the ENGINEER's inspection and acceptance.

1.3 DESCRIPTION OF PROJECT CLOSEOUT

- A. Closeout is hereby defined to include general requirements near the end of the Contract Time, in preparation for Final Acceptance, Final Payment, normal termination of Contract, occupancy by OWNER and similar actions evidencing completion of the Work.
- B. Specific requirements for individual units of Work are specified in Divisions 02 through 48.

1.4 FINAL CLEANUP

- A. At completion, leave project clean and ready for use.
 - 1. Legally dispose of waste materials, debris and rubbish off the site.
 - 2. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from exposed and enclosed surfaces.
 - 3. Repair, patch and touch up all affected curbs, gutters, and sidewalks to match adjacent surfaces.
 - 4. Broom clean paved surfaces, rake clean other surfaces of grounds. Vacuum clean all interior surfaces, rake clean other surfaces of grounds.

1.5 RECORD DRAWINGS

- A. The CONTRACTOR shall prepare and submit Contract Record Drawings for the OWNER.
 - 1. The CONTRACTOR shall make a record of changes during construction on prints of the Drawings provided by the OWNER for this purpose (Contract Record Drawings) as described in Section 01 33 00, Submittal Procedures.
 - 2. The reproducible drawings on which changed conditions are recorded shall be returned to the ENGINEER prior to project completion.

1.6 WARRANTY

- A. The General Conditions cover the CONTRACTOR's responsibility to remedy defects due to faulty workmanship and materials which appear within one year from the date of Final Acceptance.
- B. Special warranties are required by various sections of the specifications. Assemble written warranties, label and submit to the ENGINEER.
 - 1. Provide the "Warranty Form" included in the General Conditions.
 - 2. Equipment warranties shall be written in the manufacturer's standard form and shall be countersigned by the Subcontractor or SUPPLIER and the CONTRACTOR.
 - 3. All other warranties shall be written on the Subcontractor's or supplier's letterhead and shall be countersigned by the CONTRACTOR.

1.7 SPARE PARTS, SPECIAL TOOLS, AND MAINTENANCE MATERIALS

- A. Spare parts, special tools, and maintenance materials are required by various sections of the specifications.
 - 1. Parts and materials shall be packaged so as to preclude damage in normal handling and storage.
 - 2. Packages shall be labeled with full description of contents and project name and clearly identified as to which item of equipment they belong to. CONTRACTOR shall maintain a spare parts inventory list which shall be provided to the OWNER prior to Final Acceptance.
 - 3. Submit packaged parts and materials to ENGINEER.
 - 4. Submit the value of all spare parts.

1.8 FINAL INSPECTION

- A. Prior to requesting ENGINEER's final inspection for certification of Final Acceptance and Final Payment, complete the following and list known exceptions (if any):
 - 1. Submit Final Payment request with final releases and supporting documentation not previously submitted and accepted.
 - 2. Submit copy of final punchlist of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by ENGINEER.
 - 3. Submit Consent of Surety.
 - 4. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Certify in writing that the work has been completed in accordance with the Contract Documents, and request ENGINEER's final inspection.
- C. Reinspection:
 - 1. Within seven (7) days after receipt of the CONTRACTOR's notice that the work has been completed, including punchlist items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstance, the ENGINEER will reinspect the work.
 - 2. Upon completion of reinspection, ENGINEER will either prepare a certificate of Final Acceptance or advise the CONTRACTOR of work not complete or obligations not fulfilled as required for Final Acceptance.
 - 3. If necessary, inspection procedure will be repeated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 78 36

PRODUCT WARRANTY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Description of Work
 - 1. SUPPLIER shall provide warranty coverage as defined herein. If SUPPLIER is not the equipment manufacturer, then both SUPPLIER and equipment manufacturer shall provide warranty. In each case, warrantees and support shall be provided directly by the equipment manufacture and not the local manufacturer's representative. All warranties shall cover both parts and labor unless specifically noted otherwise herein, and each shall commence upon OWNER approval of successful completion of Start-up Testing per Section 01 79 00, Testing, Training and Startup.
 - 2. SUPPLIER agrees to hold OWNER harmless from liability of any kind arising from direct damage due to defects in workmanship and materials during the specified warranty periods. SUPPLIER shall make all repairs and replacements promptly upon receipt of written orders for the same from OWNER. If within 10 days after OWNER has notified SUPPLIER of a failure/defect, SUPPLIER has not started to make the necessary corrections, OWNER is hereby authorized to make the corrections or to order the work to be done by a third party, and the costs of the corrections shall be paid by SUPPLIER. Repetitive malfunction of equipment or material and equipment shall be cause for replacement and an extension of the applicable warranty period(s) for replaced material and equipment to match the term and conditions of the original warranty provided. Include in the Technical Proposal any tests and procedures required to continue the warranty following violation of a warranty or contract operating condition.
 - 3. OWNER reserves the right to renegotiate warranty terms and conditions at any time.
- B. General Equipment Warranty
 - 1. SUPPLIER shall provide warranty of the equipment and systems, covering all mechanical elements within the equipment or system scope of supply, for a minimum of one (1) year from successful completion of start-up testing or standard SUPPLIER warranty period whichever is longer. SUPPLIER shall make all repairs or replacements necessitated by equipment or material failure within the warranty period at no cost to OWNER.
- C. Warranty Exclusions
 - 1. Occurrence of any of the following shall void the warranties described in this section:
 - a. Physical abuse or misuse of equipment or materials.
 - b. Unauthorized alteration of any parts originally supplied by SUPPLIER relating to the equipment or system.
 - c. Failure strictly and exclusively to adhere to SUPPLIER specified preventative maintenance procedures, including the use of anything other than SUPPLIER approved lubricants or materials.
 - d. Failure to adhere to SUPPLIER-approved maintenance program.

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- e. Failure to maintain and provide operating records. OWNER is responsible for maintaining plant operating records from the initial start-up date until a warranty claim is made, and these records shall be available for review upon request.
- D. Equipment Failure Claim Criteria
 - 1. Provided that the equipment or system has been operated and maintained within ranges of the design criteria listed herein and SUPPLIER's recommendations (including the conditions above and the requirements listed by SUPPLIER in the Proposal Form for Procurement Contract), equipment failure is defined as failure to provide the required flow or quality characteristic for which the equipment or system was purchased.
 - a. Notification and Verification of Warranty Claims
 - 1) OWNER must provide a written notice of defect to SUPPLIER within thirty (30) days of identifying a defect.
 - 2) OWNER shall provide the following information:
 - a) A description and other documentation of the defect.
 - b) Identifying information.
 - c) Operating and repair history of the equipment.
 - 3) SUPPLIER has five (5) days to provide written response and action plan to OWNER to investigate the claim. The action plan shall be mutually agreed upon by both SUPPLIER and OWNER before implemented.
 - 4) Additional testing, onsite or offsite, may be conducted by SUPPLIER at its own cost. If the testing and investigation proves the equipment system is performing as designed and is meeting all guaranteed values, OWNER is responsible for all reasonable testing costs borne by SUPPLIER.
 - b. Satisfaction of Warranty Claims
 - 1) If the claim investigation concludes that the equipment is defective and not meeting the guaranteed performance, SUPPLIER shall make corrections, repair, replace, or other measures that provide identical or better performance than the equipment specified for the initial system within thirty (30) calendar days of receiving the written claim and resulting investigation. All costs, including materials, taxes, transit, insurance, freight, and installation for the corrections, repairs, replacements, or new equipment shall be borne by SUPPLIER with exception of the pro-rata terms defined in 1.1.D. SUPPLIER shall also provide an experienced technician for installation oversight.
 - 2) All repaired, replaced, or new equipment will assume the balance of the original warranty period defined in 1.1.D. The replacement equipment shall be compatible with the existing system and the latest generation of equipment offered by SUPPLIER.
 - 3) If SUPPLIER is unable to correct the failure condition through system corrections, repair or equipment replacement, then SUPPLIER shall be responsible for all costs associated with system corrections to regain specified performance. All correction action shall be completed within three (3) attempts or six (6) months of written action plan, whichever occurs first.
 - 4) If the corrective action described is insufficient to correct the deficiency, then SUPPLIER must remove the nonconforming equipment or system and assume all costs associated with subsequent installation of an alternate system selected by OWNER that meets the performance requirements.
- E. Warranty Services

- 1. SUPPLIER shall provide the following services during the warranty period:
 - a. Remote monitoring, if available, the equipment performance and performance reports (weekly for first six months, and then every two weeks) highlighting concerns and suggestions for improvement.
 - b. Onsite visits twice per year, with adequate onsite time to review equipment operation, for the first two years. Visits shall include observation of operations, assessment of equipment, and supplemental training of personnel. SUPPLIER representative shall be an engineer or startup technician. SUPPLIER representative's resume shall be submitted for approval by OWNER prior to scheduling visits.
 - c. Each onsite visit shall include adequate testing and analysis to determine operability or the equipment or system. The analysis is not required to be destructive but shall be determined by SUPPLIER as tests that are indicative of operation and gradual loss of effectiveness.
 - d. 24/7 continuous telephone and PLC code support if applicable.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

+ + END OF SECTION + +

DOCUMENT 01 78 51 NOTICE OF SUBSTANTIAL COMPLETION

То: _____

PROJECT DESCRIPTION: Provo Water Reclamation Facility Phase 1 Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.

This Notice of Substantial Completion applies to all work included under the Contract Documents or to the following specified parts thereof:

(Insert description of applicable parts)

The work described above and performed under this Contract has been reviewed and found substantially complete and the date of SUBSTANTIAL COMPLETION for this work is hereby established as: ______.

The guarantee period shall commence on this date.

Definition of Date of Substantial Completion: That Date certified by the OWNER/ENGINEER when the construction of the PROJECT, or a specified part thereof, is sufficiently completed in accordance with the CONTRACT DOCUMENTS so that the PROJECT, or specified part, can be utilized for the purpose for which it is intended.

A list of items to be completed or corrected, which are connected to or affected by the work described above, is attached hereto. The failure to include any items on such list does not alter the responsibility of the CONTRACTOR to complete all work in accordance with the CONTRACT DOCUMENTS. The date of commencement of guarantee for items in the attached list will be the date of final acceptance, unless agreed otherwise in writing.

	PROVO CITY CORPORATION
	Owner
	Ву
	Title
ACCEPTANCE OF NOTICE	
Receipt of the above NOTICE OF SUBS	STANTIAL COMPLETION is hereby acknowledged
Ву	
this theday of	,
E	ND OF DOCUMENT

Notice of Substantial Completion 01 78 51 - 1

Notice of Substantial Completion 01 78 51 - 2

DOCUMENT 01 78 52 NOTICE OF FINAL ACCEPTANCE

То: _____

PROJECT DESCRIPTION: Provo City Water Reclamation Facility Phase 1, Electrical Refeed Packages A-E, Bid No. PROVOEN202529386.

A final inspection of the WORK completed under the Contract indicated above has been made and all WORK has been found to be completed. All known changes to the WORK have been documented and approved at this time and to the best of our knowledge, information, and belief. The work required by this Contract has been performed and completed in accordance with the approved DRAWINGS, SPECIFICATIONS, and other CONTRACT DOCUMENTS. Final payment for the Contract has therefore been requested and should follow shortly.

Thank you for your effort and cooperation towards the successful completion of this WORK.

	PROVO CITY CORPORATION
	Owner
	Ву
	Title
ACCEPTANCE OF NOTICE	
Receipt of the above NOTICE OF FINAL AC	CEPTANCE is hereby acknowledged
Ву	
this theday of	/

END OF DOCUMENT

Notice of Final Acceptance 01 78 52 - 1

Notice of Final Acceptance 01 78 52 - 2

SECTION 01 79 00

TESTING, TRAINING AND STARTUP

PART 1 - GENERAL

1.1 GENERAL

- A. Scope:
 - 1. This section covers general equipment and system testing and startup requirements, services of the manufacturer's representatives and special coordinating services required of the CONTRACTOR that shall apply during construction and training of the OWNER's personnel for facilities operation.
 - 2. Specific testing and tracking procedures and requirements found in the Technical Specifications shall also apply.
- B. The CONTRACTOR shall inform all Subcontractors and manufacturers of the requirements herein and include the required services in their costs for the work specified in these Contract Documents. Where a minimum amount of time is stated in the Technical Specifications for manufacturers' services, any additional time required to perform the specified services shall be provided at no additional cost to the OWNER.
- C. Scheduling:
 - 1. Equipment testing and plant startup are requisite to satisfactory completion of the Contract and, therefore, shall be completed within the contract time.
 - All equipment testing and plant startup activities shall be realistically allowed for and shown on the CONTRACTOR's Construction Schedule, in accordance with Section 01 32 13, Progress Schedule.
 - 3. All equipment testing and plant startup activities shall be scheduled in conformance with the restrictions specified in Section 01 13 00, Special Project Constraints.
- D. Equipment testing shall be satisfactorily completed prior to commencing plant startup associated with the particular equipment item or equipment package. The equipment shall not be considered ready for testing until the following conditions are satisfied:
 - 1. Manufacturer's certification of equipment installation has been accepted by the ENGINEER.
 - 2. Electrical and/or instrumentation Subcontractor certification of motor control logic has been accepted by the ENGINEER.
 - 3. Related Technical Submittals, O&M Manual and Final Shop Drawings have been accepted by the ENGINEER.
 - 4. Operator training services have been furnished by the CONTRACTOR (operational testing only).
 - 5. Testing procedures have been submitted in writing and accepted by the ENGINEER in accordance with Section 01 33 00, Submittal Procedures. All testing procedures and results shall be submitted in writing.
- E. The requirements of plant startup specified herein shall also apply to the startup of individual treatment plant processes and facilities.

- F. Startup Plan:
 - 1. Not less than 3 months prior to initial equipment or system startup, the CONTRACTOR shall submit to the ENGINEER for review, a detailed Facilities Startup Plan for the associated items of equipment and/or systems.
 - 2. The Startup Plan shall include:
 - a. A detailed sub-network of the CONTRACTOR's Construction Progress Schedule including the following activities:
 - 1) Manufacturer's Services;
 - 2) Installation Certifications;
 - 3) Operator Training;
 - 4) O&M Manual;
 - 5) Functional Testing;
 - 6) Performance Testing;
 - 7) Operational Testing;
 - 8) All other activities necessary to affect a coordinated and successful Testing, Training and Startup.
 - b. Written testing plan with proposed data logs for each item of equipment to be tested.
 - c. A discussion of any coordination required with the Owners staff and/or any system or equipment outage requirements.
 - d. The Plan shall be updated and/or revised as necessary prior to subsequent Construction Progress Meetings.
 - e. Testing shall not be scheduled earlier than 30 days after approval of the Plan.

1.2 SERVICES DURING CONSTRUCTION

- A. General:
 - 1. Manufacturer's Representative:
 - a. The CONTRACTOR shall provide the services of competent and experienced technical representatives of the manufacturers of all equipment and systems furnished under the contract, for as many days as may be necessary for assembly, installation, testing assistance and operator training.
 - b. Manufacturer's field representatives shall observe, instruct, guide, and direct CONTRACTOR's erection or installation procedures, or perform an installation check, as required.
 - c. In each case, the CONTRACTOR shall arrange to have the manufacturer's representative revisit the job site as often as necessary until operator training is complete and testing and startup problems have been resolved to the satisfaction of the ENGINEER.
 - d. This requirement applies to manufacturers of all equipment furnished (excluding manually operated valves smaller than 24 inches in size, and any other items of equipment specifically exempted by the ENGINEER in writing), whether or not specifically set forth in the Technical Specifications.
 - e. The CONTRACTOR shall maintain a service record on each item of equipment and shall deliver these service records to the ENGINEER prior to acceptance of operational testing.
- B. Fulfillment of Specified Minimum Services:
 - 1. The CONTRACTOR shall obtain prior written approval from the ENGINEER for providing manufacturers' services.

- 2. All requests to the ENGINEER for prior approval shall (1) be in writing, (2) be submitted not less than 10 calendar days prior to the providing of the subject services, (3) state the service to be provided, and (4) state the reason(s) why the timing of the service is appropriate.
- 3. Request made to the ENGINEER less than 10 calendar days prior to the manufacturers' services may not receive consideration and response prior to the times the services are provided.
- 4. Visits of manufacturers and their representatives to the jobsite or training classroom without prior approval as provided herein may not act to fulfill the specified minimum man-day requirements.
- C. Certificate of Proper Installation:
 - 1. Equipment requiring factory tests shall not be delivered to the jobsite until the CONTRACTOR submits acceptable certified test results to the ENGINEER.
 - 2. Equipment shall not be considered ready for functional testing until after the following certifications have been submitted and accepted by the ENGINEER.
 - a. Manufacturer Representatives:
 - The CONTRACTOR shall require that each manufacturer's representative furnish to the ENGINEER a written and signed report addressed to the OWNER certifying that the equipment has been properly installed, adjusted, lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated satisfactorily under full-load conditions and is ready for full-time operation.
 - 2) For pumps, compressors, blowers, engines, motors, and other rotating or reciprocating equipment, the report shall certify that the equipment operates within the manufacturer's allowable limits for vibration.
 - 3) The report shall also certify that all controls, protective devices, instrumentation, and control panels furnished as part of the manufacturer's equipment package are properly installed and calibrated; and that the control logic for equipment startup, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
 - 4) The CONTRACTOR shall also sign said certification.
 - 5) The CONTRACTOR shall submit "Manufacturer's Certification of Proper Installation" on the OWNER form.
 - b. Electrical and Instrumentation Subcontractor:
 - The CONTRACTOR shall require that the electrical and/or instrumentation Subcontractor shall furnish a written and signed report to the ENGINEER certifying that the motor control logic for the equipment item that resides in motor control centers, control panels, control boards, microprocessors, distributed processing units, computers, and the like furnished by the electrical and/or instrumentation Subcontractor has been properly tested and calibrated.
 - The report shall certify that the control logic for equipment startup, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
 - 3) The CONTRACTOR shall also sign said certification.

1.3 STARTUP AND TESTING

- A. General:
 - 1. The CONTRACTOR shall provide the effective coordination of all parties necessary for the successful project startup.

- 2. The ENGINEER shall not be responsible to instruct the CONTRACTOR in the startup of the project, however, the ENGINEER will be available prior to and during startup to provide operational and technical support to the CONTRACTOR.
- 3. The CONTRACTOR shall furnish all labor, consumables (power, water, chemicals, air, etc.) tools, equipment, instruments, and services required and incidental to completing all functional, performance and operational testing of installed equipment.
- 4. The CONTRACTOR shall submit the proposed test procedures to the ENGINEER for review at least 30 days prior to testing.
- 5. The CONTRACTOR shall give the ENGINEER written notice confirming the date of testing at least five working days before the time the equipment is scheduled to be tested.
- 6. All testing shall be witnessed by the ENGINEER to be considered valid.
- 7. Test Reports:
 - a. CONTRACTOR shall submit written detailed results of all functional, performance and operational testing.
 - b. Upon successful completion of Operational testing all equipment installation, testing and maintenance records shall be submitted to the ENGINEER.
 - c. Said records shall be bound separately for each piece of equipment or system and shall be collected by type of record.
- 8. For factory tests, written test results shall be submitted to the ENGINEER at least 10 days prior to shipment.
- B. Functional testing:
 - 1. All items of mechanical and electrical equipment shall be functionally tested by the CONTRACTOR after installation for proper operation.
 - 2. A minimum of ten (10) days prior to the start of functional testing, the CONTRACTOR shall submit interconnection diagrams for the equipment and for the alarms, controls and instruments associated with the equipment. This requirement shall not relieve the CONTRACTOR of meeting any requirements in the technical specifications for earlier submittal of the interconnection diagrams.
 - 3. Minimum Test Requirements
 - a. The functional test of each piece of mechanical equipment shall continue for not less than eight (8) continuous hours without interruption.
 - b. The functional test shall include checking for proper rotation, alignment, speed, flows, pressure, vibration, sound level, etc. Initial equipment and system adjustment and calibrations shall be performed in the presence of and with the assistance of the manufacturer's representative.
 - c. The functional test shall include a demonstration of the proper performance of all alarms, local and remote controls, instrumentation, equipment functions, and all other electrical, mechanical and piping systems.
 - d. All parts shall operate satisfactorily in all respects, under continuous full load, and in accordance with the specified requirements, for the full duration of the eight-hour test period.
 - e. If any part of a unit shows evidence of unsatisfactory or improper operation during the eight-hour test period, correction or repairs shall be made and the full eight-hour test operation, as specified herein, shall be repeated after all parts operate satisfactorily.
- C. Performance testing:
 - 1. Where performance testing is required by the Technical Specifications, the testing shall be supervised by the manufacturer's representative. These services shall continue until such times as the applicable equipment or system has been

successfully tested for performance and has been accepted by the ENGINEER for operational testing.

- 2. Performance testing shall take place after functional testing is successfully completed in accordance with Article 1.3 B.
- 3. Performance testing shall demonstrate that the equipment meets all performance requirements specified.
- D. Startup/operational testing:
 - 1. Upon successful completion of operator training and the functional, performance and leakage testing, the CONTRACTOR shall startup the plant facilities and test the equipment operation and performance by conducting a seven (7) day, continuous operational test of the completed facilities as an operational process unit to demonstrate to the ENGINEER's satisfaction that all equipment and systems required by these specifications will operate in the manner in which they are intended to perform.
 - 2. The OWNER will provide CONTRACTOR-trained operating personnel for the duration of the operational test. Said operation shall be conducted and under the supervision and direction of the CONTRACTOR and/or manufacturer's representative.
 - 3. Operational Defects:
 - a. All defects in materials or workmanship which appear during the operational test shall be immediately corrected by the CONTRACTOR.
 - b. In the event of a malfunction or deficiency that results in shutdown or partial operation of a system or process unit or results in performance that is less than that specified, the startup duration shall be repeated for that corresponding system or process unit and any other affected equipment so its proper operation and performance as required by the Contract Documents is demonstrated for a minimum of seven (7) continuous and trouble free days.
 - 4. If the operational test is interrupted through no fault of the CONTRACTOR the test may resume at the earliest mutually agreeable time.
 - 5. No unit process or part thereof shall be placed in service until it has successfully completed operational testing.
 - 6. During plant startup, the CONTRACTOR shall provide the appropriate construction trades and the services of authorized Manufacturer's representatives for operational testing and as necessary, to correct faulty equipment operation.
 - 7. After completion of all startup/operational testing, the CONTRACTOR shall repaint, hose, scrub, clean up and otherwise return the work to a "like new" condition, prior to OWNER acceptance.

1.4 TRAINING OF OWNER PERSONNEL

- A. General:
 - 1. Operation and maintenance training of OWNER's personnel shall be provided for mechanical, electrical, instrumentation and control equipment as listed in this section or elsewhere in the specifications.
 - 2. For the purposes of this requirement, operations training is considered to be separate from maintenance training. Instructions are to be tailored to the needs of each group.
 - These training services shall be conducted by the manufacturer's representative and shall ensure measurable and observable means that OWNER personnel are qualified to perform equipment task requirements, including essential knowledge, skills and abilities.

- 4. Training shall be conducted by competent representatives who are certified by the manufacturer to be thoroughly familiar with the subject matter as well as instructional methods.
- 5. Training materials shall be submitted to the OWNER (see Paragraph 1.4 C below) for review. Acceptance of training materials is required prior to start of training.
- 6. All training shall be completed prior to beginning operational testing.
- 7. The OWNER shall have the right to videotape any or all training sessions or may designate separate sessions or portions thereof for the sole purpose of videotaping.
- B. Training coordinator:
 - 1. The CONTRACTOR shall designate and provide one or more persons to be responsible for coordinating and expediting training duties.
 - 2. The person or persons so designated shall be present at all training coordination meetings with the OWNER.
- C. Training schedule:
 - 1. The CONTRACTOR's coordinator shall coordinate the training periods with OWNER's personnel and manufacturer's representatives and shall submit a training schedule and the training materials for each piece of equipment or system for which training is to be provided.
 - 2. The training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the then current Plan of Operation.
 - 3. Equipment and/or systems shall be deemed suitable for use in training upon satisfactory completion of functional testing.
 - 4. All training with regards to a unit process or part thereof shall be completed prior to the start of operational testing.
 - 5. A schedule of equipment training will be provided for each package. See Section 01 79 00 SC, Testing, Training, and Startup Schedule.
 - 6. The CONTRACTOR shall provide distinct and separate training sessions for both operations and maintenance personnel, meeting the following criteria:
 - a. Maintenance Training:
 - 1) Maintenance training shall be provided for each unit operation identified for operational training.
 - 2) The CONTRACTOR shall provide two (2) separate training sessions on a schedule agreed to by ENGINEER and OWNER.
 - 3) Training shall emphasize theory of operations, troubleshooting, and preventative maintenance and repair procedures.
 - 4) The discussion shall encompass issues relating to instrumentation, electrical, and mechanical systems.
 - b. Operations training:
 - 1) Operations training shall be provided for each unit of operation.
 - 2) The CONTRACTOR shall provide two (2) separate training sessions for each three (3) operating shifts.
 - 3) Sessions are to be provided on Wednesdays between 6:00 a.m. and 12:00 p.m.
 - c. Training session schedules shall be approved by the ENGINEER.
 - d. Training shall emphasize theory of operations, startup instructions, emergency and normal shutdown instructions, lockout procedures, troubleshooting, preventative maintenance, and alarm and control logic.
 - 7. The CONTRACTOR shall confirm each training period a minimum of three working days prior to the schedule time.

- 8. If a manufacturer's representative fails to conduct a scheduled training class, the CONTRACTOR hereby agrees to compensate the OWNER for labor costs, including overhead, for all OWNER personnel in attendance for the entire scheduled training period.
- 9. If the CONTRACTOR or the manufacturer's representative fails to provide training that qualifies the OWNER personnel to perform equipment task requirements, the CONTRACTOR hereby agrees to provide remedial training to ensure OWNER personnel proficiency at no additional cost to the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 RECORD KEEPING

- A. The CONTRACTOR shall maintain as a minimum, the following records:
 - 1. Equipment manufacturer's shop drawings.
 - 2. Daily logs indicating all equipment testing and startup activities.
 - 3. Log and time sheets of all manufacturer's representatives performing services on the jobsite.
 - 4. Updated equipment testing and startup schedules.
 - 5. Records of system cleaning.
 - 6. Hydrostatic and pressure test records.
 - 7. Equipment alignment and vibration measurements and corrective actions.
 - 8. Equipment lubrication records.
 - 9. Insulation resistance measurements.
 - 10. Electrical phase, voltage and amperage measurements.
 - 11. Electrical breaker inspection, test, and adjustment records.
 - 12. Logs of abnormal circuits and lifted wires.
 - 13. Testing and validation of all central and alarm functions.
 - 14. Data sheets of all testing and calibration of instrumentation devices and control loops including documentation of set points.
 - 15. Equipment and system release logs (from construction to startup).
 - 16. Daily work reports.

3.2 GENERAL PROCEDURES

- A. The general work procedures listed below outline the work to be performed by the CONTRACTOR. Additional procedures applicable to specific equipment items are specified elsewhere.
- B. Technical assistance and support:
 - 1. Obtain the assistance of the appropriate construction trades and the manufacturer or vendor, as required for technical assistance during equipment installation, testing, and startup by the CONTRACTOR and for training of the OWNER's Operation and Maintenance personnel.
 - 2. Furnish names and telephone numbers of manufacturer's and vendor's current technical service representatives for use by the ENGINEER.
- C. Instructions:

- 1. Maintain an adequate manufacturer's instruction file so that the information will be readily available during equipment testing and startup.
- 2. Prior to equipment testing, finalize, and transmit to the ENGINEER the applicable technical manuals as required under Section 01 33 00, Submittal Procedures of the Contract Specifications.
- D. Removal of rust preventives:
 - 1. Prior to equipment testing, remove all rust preventives and oils used to protect the equipment during the construction period whenever these protective materials will be detrimental to operation or equipment maintenance.
- E. Lubricants:
 - 1. At least 60 days prior to startup, provide a list of the manufacturer's recommended lubricants for use in the plant. All equipment lubrication shall be listed with the lubricant types and quantities recommended and approved by the equipment manufacturers.
 - 2. Provide the necessary lubricants for startup and the initial 60 days of operation.
 - 3. Flush systems and install the initial charge of all lubricants. Dispose of flushing oil in accordance with applicable regulations.
 - 4. The CONTRACTOR shall lubricate the equipment in accordance with the manufacturer's recommendations until the equipment is accepted by the OWNER.
 - 5. Maintain a lubrication record for each item of equipment. The CONTRACTOR shall submit the lubrication records to the ENGINEER prior to equipment testing.
- F. Packing and seals:
 - 1. Install, adjust, and replace packing, mechanical seals, and accessories, as necessary, during the equipment testing and startup period.
 - 2. Adjust seal water and flushing water flow rates in accordance with the equipment manufacturer's recommendations.
- G. Removal of temporary bracing:
 - 1. Prior to equipment testing, remove all temporary supports, bracing, or other foreign objects that were installed in vessels, transformers, rotating machinery, or other equipment to prevent damage during shipping, storage, and erection, and repair any damage sustained.
- H. Rotation, alignment, and vibration:
 - 1. Prior to equipment testing, check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting the driver.
 - 2. Prior to equipment testing, perform the cold alignment and hot alignment to the manufacturer's tolerances.
 - 3. Prior to equipment testing, test equipment vibration and correct any vibration in excess of the manufacturer's recommendation.
- I. Tie-ins at the contract limits:
 - 1. Provide proper notification, preparation, and coordination for safe tie-ins and minimal interference with the plant operation.
 - 2. Obtain approval and make the necessary tie-ins at the unit limits as required by the Contract Documents and as approved by the ENGINEER.
 - 3. Prior to startup, remove the temporary blind flanges, plugs, bulkheads, seals, etc.

3.3 SPECIFIC PROCEDURES

- A. In addition to the work responsibilities described in paragraph 3.2, the procedures outlined below further define the work responsibilities of the CONTRACTOR for specific systems and items of equipment.
- B. Mechanical equipment:
 - 1. Level baseplates and soleplates and grout under all load bearing surfaces.
 - 2. Install suitable supports and flexible connections to alleviate any piping stresses that may be imposed on pumps, compressors, and drivers.
 - 3. In accordance with the manufacturer's recommendations, chemically clean lube oil, seal oil, and cooling systems. Dispose of waste and cleaning media in a manner that is acceptable to and approved by the OWNER and applicable regulatory agencies.
 - 4. In accordance with the manufacturer's recommendations, charge the lube oil, seal oil, and cooling systems with flushing media and circulate for cleaning purposes. Dispose of any flushing media in a manner that is acceptable to and approved by the OWNER and applicable regulatory agencies.
 - 5. Charge the lube oil systems, seal oil systems, and cooling systems with the amount and type of operating oil or coolant recommended by the manufacturer.
 - 6. Operate the equipment and check for excessive vibration, abnormal operating noises, overheating and lubricant leakage, etc., and test any safety shutdown/alarm devices for proper operation, and make any operating tests required by the ENGINEER. The adjustments required for proper operation shall be made prior to operational testing.
 - 7. Utilize manufacturer's representative for technical assistance during installation and startup.
 - 8. Prior to startup, all sidewalks, gratings, handrails, safety chains, safety shields, etc., shall be installed.
 - 9. Prior to startup, demonstrate to the ENGINEER's satisfaction that all chemical solution pipelines are connected to the intended tank(s), feeder(s), pump(s), and application points, and that the pipes, appurtenances contained therein and diffusers will operate at the intended flow rates.
 - 10. Prior to startup, the applicable safety equipment, emergency shower and eyewash units, fire extinguishers, fire suppression equipment, self-contained breathing apparatus, toxic and/or combustible gas detectors (including the respective personnel warning system), protective clothing, emergency repair kits, etc., shall be installed in an acceptable manner-subject to the ENGINEER's approval, and be fully ready for operation.
 - 11. All safety hazards, e.g., exposed drive shafts or rotating equipment members, exposed electrical circuitry, open electrical junction boxes and panels, improperly supported piping and conduits, missing safety devices, etc., shall be corrected prior to supplier training of the OWNER's personnel.
 - 12. The CONTRACTOR shall perform a comprehensive safety inspection and correct any safety deficiencies found before implementing plant startup.
 - 13. Roadways that are required for ambulance service, fire fighting access, delivery of treatment chemicals and supplies, and disposal of the treatment byproducts shall be completed prior to startup.
 - 14. Prior to startup, install all warning and safety signs, labels, and devices.
- C. Tanks:
 - 1. Test all tanks and internals, as required to demonstrate conformance to the Contract Documents. Dispose of test media in a manner that is acceptable to and approved by the OWNER and the applicable regulatory agencies.

- 2. Prior to startup, conduct chemical cleaning or flushing operations as specified. Dispose of wastes and cleaning media in a manner that is acceptable to and approved by the OWNER and the applicable regulatory agencies.
- 3. Prior to startup, install all chemical identification, warning, and safety signs and labels.
- D. Electrical power and lighting systems:
 - 1. Provide the ENGINEER with 3-day advance notification in writing of the test schedule. The CONTRACTOR is advised that the tests shall be witnessed by the ENGINEER.
 - 2. Perform insulation resistance tests on all wiring 120 volt and larger. Do not meggar instruments or solid-state devices.
 - 3. Perform insulation resistance tests on all motor and transformer windings from phase to phase and phase to ground.
 - 4. Perform grounding system tests to determine the continuity of connections and the value of resistance to ground.
 - 5. Fill electrical gear with oil and/or other media as recommended by the equipment manufacturer.
 - 6. Prior to substantial completion and startup, test and set switchgear and circuit breaker relays for proper coordination and operation.
 - 7. The CONTRACTOR shall obtain the services of a qualified "independent testing service", member of the National Electric Testing Association, to perform a thermographic survey on all switchgear buses, insulators and power connections when energized and under at least 20 percent load. Significant hot spots shall be further checked by infrared pyrometer for exact temperature rise. The CONTRACTOR shall troubleshoot and correct the thermographic hot spots. Correction shall be verified by repeating the thermographic survey at no additional cost to the OWNER.
 - 8. The CONTRACTOR shall obtain the services of a qualified "independent testing service", member of the National Electric Testing Association, to inspect and test the protective relays and the 800-ampere and larger drawout breakers for proper installation, adjustment, and operation in accordance with the manufacturer recommendations.
 - 9. The CONTRACTOR shall obtain the services of a qualified "independent testing service", member of the National Electrical Testing Association, to perform DC high potential tests on all cables that will operate at more than 2,000 volts to ground.
 - 10. Obtain local electrical inspector's approval where required.
 - 11. Energize all substations, with approval of the Utility Company and the ENGINEER after completion of all electrical testing.
 - 12. Prior to startup, perform tests and adjustments on all switchgear and motor control equipment to demonstrate proper operation and conformance to the Contract Documents and manufacturer's recommended settings.
 - 13. Prior to startup, test installation of emergency power and lighting systems for proper operation, including light intensity.
 - 14. Prior to startup, provide the ENGINEER with a record of all test data and the work completed.
 - 15. Vacuum clean all electrical equipment prior to startup and acceptance.
- E. Piping systems:
 - 1. Provide the ENGINEER with 3-day advance notification in writing of test schedule.
 - 2. Hydrostatically or pneumatically test all piping as required by the codes and contract documents.
 - 3. After successful testing of the piping, slowly drain the system and then flush the system. Orifice plates shall be installed after testing. If installed with the piping,

they will be removed and replaced with spacers or pipe spools of equal length prior to the pressure test.

- 4. Dewater the system, remove blind flanges, and perform tightness tests, as required by the ENGINEER.
- 5. Insulate or paint piping, flanges, threaded joints, or field welds after the specified testing of each item has been completed unless instructed otherwise by the ENGINEER.
- 6. Leave exposed all welded joints (longitudinal, girth, and nozzle) in underground piping that have not been shop tested until the specified testing has been completed. After final testing of these joints, cover the system.
- 7. Prior to substantial completion and startup, check pipe hangers, supports, guides, and pipe specialties for the removal of all shipping and erection stops and for the correctness of the cold and hot settings for the design service, make adjustments as necessary to obtain proper installation. Provide the ENGINEER with instructions for the hot settings.
- 8. As necessary during equipment testing and at the end of substantial completion and startup, clean or replace the screens and filter elements as appropriate for the filter type and service.
- 9. Prior to startup, verify, to the extent required by the ENGINEER, that specified valve packing has been provided on valves installed in the plant.
- 10. Prior to startup, install all of the valve and piping system identification labels.
- 11. Prior to startup, check and record the position of all process system valves.
- 12. Prior to startup, correct support, vibration, and thermal expansion problems detected during the preliminary equipment testing.
- 13. Prior to the startup, retorque all hot and cold service bolting as required to ensure a permanent and proper installation.
- 14. Prior to startup, demonstrate to the ENGINEER's satisfaction that each piping system (e.g., chemical, sample, utility, irrigation process, etc.) functions as designed and required by the Contract Documents.

+ + END OF SECTION + +

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DEFINITIONS

- A. "Demolish": CONTRACTOR shall remove from the site as property of CONTRACTOR. Demolition includes disconnecting, removal, loading, repairs, cleanup, transportation, unloading, disposal permits and fees, disposal, and all other items required to remove the material from the site.
- B. "Salvage": CONTRACTOR shall remove from area of Work and place in location designated by ENGINEER. Equipment is property of OWNER. Salvage includes disconnecting, removal, repairs, cleanup, loading, transportation, unloading, and all other items required to remove and relocate the material.
- C. "OWNER to Remove": OWNER will remove from area of Work prior to CONTRACTOR commencing demolition Work for this area.
- D. "Relocate": CONTRACTOR shall relocate material shown to new locations shown on Drawings or stated herein. Relocation includes disconnecting, removal, reconnecting, attaching, repairs, and all other items required to relocate material to new location.
- E. "Abandon": CONTRACTOR shall disconnect and leave in place as specified.
- F. "Materials": Any and all items and objects that are scheduled, specified, or shown to be demolished, salvaged, removed, relocated, or abandoned.

1.2 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Action Submittals:
 - 1. Product Information: Grout, sealants, and bonding agents to be used for patching.
- C. Informational Submittals:
 - 1. Plan and schedule phased demolition, including limits of demolition, as part of and consistent with the progress schedule specified in Section 01 32 13, Progress Schedule.
 - 2. Methods of demolition and equipment proposed to demolish materials.
 - 3. Copies of any authorizations and permits required to perform Work.
 - 4. Copies of Hazardous Materials Inspection Reports.
 - 5. Repair procedures for demolition of materials beyond limits shown on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. CONTRACTOR shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the Work shown, specified herein, and as required to complete the Work.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings are based on available information. The Work may differ slightly from what is shown. CONTRACTOR shall be responsible for determining the work required by inspecting the site.

3.2 SAFETY REQUIREMENTS

- A. All Work shall be done in conformance with all applicable rules and regulations pertaining to safety.
- B. Hazardous Materials:
 - 1. See General Conditions.
 - 2. Existing facilities, or portions thereof, to be demolished may contain hazardous materials such as asbestos cement piping, residual chemicals in existing or abandoned piping, lead-based paint, mercury seals, or other unknown hazardous materials.

3.3 SEQUENCE

- A. Be responsible for the sequence of Work.
- B. Conform to constraints as specified in Section 01 13 00, Special Project Constraints.

3.4 COORDINATION

- A. Coordination with ENGINEER:
 - 1. Only materials specified herein, shown on the Demolition Photographs or the Drawings, or approved by ENGINEER in the field shall be demolished, salvaged, removed, relocated, or abandoned.
 - 2. Verify materials scheduled to be demolished, salvaged, removed, relocated, or abandoned with ENGINEER prior to performing Work.
 - 3. Do not remove materials without prior approval of ENGINEER.
 - 4. Provide at least 3 working days' notice to ENGINEER prior to start of Work.
 - 5. Notify ENGINEER to turn off affected services or facilities before starting Work.
 - 6. Provide temporary services during interruptions to affected services or facilities as acceptable to ENGINEER.
 - 7. ENGINEER will indicate limits of Work if not clearly shown.
- B. Coordination with Utility Owners:
 - 1. Notify utility owners to turn off affected services or facilities before starting Work.
- 2. Provide not less than 72 hours' notice to utility owners prior to shutdown, unless otherwise directed by utility owners.
- 3. Provide temporary services during interruptions to affected services or facilities as acceptable to utility owners.

3.5 LIMITS

- A. Drawings define minimum portions of materials to be demolished. Unless otherwise shown, rough cuts or breaks may be made to limits of demolition shown. If rough cuts or breaks are made exceeding limits shown, CONTRACTOR shall repair the cuts or breaks back to the dimensions shown on Drawings at CONTRACTOR's expense.
- B. If limits are not clear on the Drawings or Demolition Photographs, limits shall be as directed by ENGINEER.
- C. All areas not within the limits of demolition Work shown on the Drawings, or as specified herein, shall be left undisturbed, unless necessary for demolition of materials.

3.6 DEMOLITION

- A. General:
 - 1. Inspect condition of materials to be demolished prior to bidding to assess potential for salvage value.
 - 2. Remove all materials associated with existing equipment that is to be demolished.
 - 3. Materials within limits of demolition will become the property of CONTRACTOR.
 - 4. All materials from the demolition process shall be removed safely from the project site as soon as possible. They shall be disposed of in accordance with applicable federal, state, and city regulations. CONTRACTOR is responsible for determining these regulations and shall bear all costs associated with disposal of the materials.
- B. Pavement and Curbs:
 - 1. Curbs are to be demolished to the nearest joint(s)
 - 2. Provide saw cut at all concrete and pavement surfaces and curb removal limits and where neat connection lines are required.
 - 3. Surfaces exposed by demolition activities shall be repaired and finished to provide a uniform, smooth, level transition between adjacent surfaces.
- C. Concrete, CMU, and Reinforcing:
 - 1. In areas where concrete or CMU portions are to be removed from a structure, the edge of removal shall be cut with a concrete saw to leave a perpendicular edge or by core-drilling where a circular hole is required.
 - 2. Damaged concrete shall be removed to solid concrete. Damaged concrete shall include concrete that is soft, spalled, cracked, or otherwise damaged as determined by ENGINEER.
 - 3. Depth of removal shall be as determined by ENGINEER unless otherwise shown or specified.
 - 4. Reinforcing shall be cut and removed unless otherwise shown or instructed by ENGINEER.
 - 5. Spalled edges may require saw cutting at the discretion of the ENGINEER.
 - 6. Protect adjacent structures and equipment from damage during Work.
 - 7. Exposed surfaces following demolition activities shall be repaired and finished to provide a uniform, smooth, and level transition between adjacent surfaces.

- 8. Remove and repair designated cracked and damaged concrete areas shown in accordance with this section and Section 03 30 00, Cast-in-Place Concrete.
- D. Concrete Embedded Items:
 - 1. Except for core drills, demolish anchor bolts, reinforcing steel, conduit, and other materials that are concrete embedded to a minimum of 1 inch below final finished surface. For core drills, coat rebar exposed by core drilling with System No. 304 in accordance with Section 09 90 00, Painting.
 - 2. Plug empty pipes and conduits with fireproof sealant to maintain fire ratings for floors or walls.
 - 3. Patching:
 - a. Demolish damaged concrete. Damaged concrete shall be removed to solid concrete. Damaged concrete shall include concrete that is soft, spalled, cracked, or otherwise damaged as determined by ENGINEER.
 - b. Coat with approved bonding agent.
 - c. Patch with non-shrink, nonmetallic grout.
- E. Piping:
 - 1. Pressurized Services: Install restrained caps or plugs at the demolished ends, unless otherwise shown.
 - 2. Gravity Services: Install concrete plugs, 5-foot minimum length.
- F. Utilities:
 - 1. Excavate utility lines serving structures to be demolished.
 - 2. Demolish electrical, sanitary, and storm drainage lines serving structures to be demolished.
 - 3. Support or relocate utility lines exposed by Work.
 - 4. For water and gas lines to be demolished or capped and terminated, provide a permanent leakproof closure. Closure type shall be as recommended by utility owner.
- G. Electrical:
 - 1. Remove conduits and wiring from materials to be demolished back to nearest junction box.
 - For existing circuits to remain operational, intercept existing conduit at the most convenient location, or as shown, and splice and extend conduit to new location. Install new conductors as required to accomplish intended results. New conductors shall be continuous without splices between junction boxes.
 - 3. For existing circuits no longer needed, demolish conductors from conduits.
 - 4. Demolish all surface-mounted conduit which is no longer needed.
 - 5. For conduit below grade or concealed within walls, cap and abandon in place.

3.7 SALVAGE

- A. Salvage materials for OWNER's own use where shown.
- B. Remove materials with extreme care so as not to damage.
- C. Promptly remove materials from Work area.
- D. Store materials in location designated by ENGINEER.
- E. Clean and protect materials from dust, dirt, natural elements, and store as directed.

3.8 RELOCATION

- A. ENGINEER will determine condition of materials prior to removal.
- B. Remove all materials associated with items to be relocated.
- C. Existing materials shall not be damaged during removal.
- D. Properly store and maintain materials in same condition as when removed.
- E. Clean and protect materials from dust, dirt, natural elements, and store as directed.

3.9 ABANDONMENT

- A. Structures: Break holes into or core drill floor slabs, catch basins, and other below-grade concrete structures to be abandoned in place to allow water to freely migrate through.
- B. Piping and Conduits:
 - 1. General: Piping and conduits to be abandoned shall be capped with a watertight plug at demolished end in a manner that will prevent entrance of soil, groundwater, or moisture.
 - 2. Pressurized Services: Install restrained caps or plugs at the demolished ends, unless otherwise shown.
 - 3. Gravity Services: Install concrete plugs, 5-foot minimum length.

3.10 REPAIR AND REPLACEMENT

- A. Any damaged materials scheduled to be salvaged or relocated shall be repaired by the CONTRACTOR to the satisfaction of ENGINEER or replaced at the CONTRACTOR's expense.
- B. Any damage to areas not within the limits of demolition Work shown on the Demolition Photographs, Drawings, or as specified herein shall be repaired or replaced to original precontract conditions at the CONTRACTOR's sole expense.

3.11 DISPOSAL

A. Dispose of materials offsite in licensed landfills and in accordance with all local, state, and federal regulations. CONTRACTOR is responsible for obtaining any and all necessary permits for disposal.

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SECTION 03 01 30.71

REHABILITATION OF CAST-IN-PLACE CONCRETE

<u> PART 1 - GENERAL</u>

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, all existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - 2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
 - 4. ASTM D3574, Test Methods for Flexible Cellular Materials Slab, Bonded, and Molded Urethane Foams.
 - 5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.
 - 6. NSF/ANSI 61, Drinking Water System Components Health Effects

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Information on all products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
 - 2. Site Quality Control Submittals: Results of specified Site quality control testing.
 - 3. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling of Materials:

- 1. Conform to Section 01 66 00, Transportation and Handling of Goods.
- 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
- 3. Handle materials carefully to prevent inclusion of foreign matter.
- 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:
 - 1. Conform to Section 01 66 10, Product Storage Handling and Delivery, and this Section.
 - 2. Store only approved materials at the Site.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIRMENTS

A. Repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.2 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.
- B. Products and Manufacturers: Provide one of the following:
 - 1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, by Sika Corporation.
 - 2. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.
 - 3. Or equal.
- C. Materials:
 - 1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowelgrade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

		ASTM	
Physical Property	Value	Standard	
Minimum Compressive Strength at One Day	2,000 psi	C109	
Minimum Compressive Strength at 28 Days	6,000 psi	C109	
Minimum Bond Strength at 28 Days	1,800 psi	C882*	
* Modified for use with repair mortars.			

- 2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.
- 3. Product shall be listed in NSF/ANSI 61.

2.3 REPAIR OF EXPOSED REINFORCING STEEL

- A. System Description: System for repair of exposed reinforcing steel shall consist of two components: an initial application of corrosion inhibitor and subsequent application of protective slurry mortar.
- B. Corrosion Inhibitor:
 - 1. Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika FerroGard 903, by Sika Corporation.
 - b. Or equal.
 - 3. Corrosion inhibitor shall:
 - a. Not change the substrate's color, appearance, or texture.
 - b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.
 - c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.
 - d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.
 - e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.
 - f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.
 - g. Product shall be listed in NSF/ANSI 61.
- C. Protective Slurry Mortar:
 - 1. Material shall be two-component, polymer-modified, cementious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikatop Seal 107, by Sika Corporation.
 - b. Or equal.
 - 3. Product shall be listed in NSF/ANSI 61.

2.4 CRACK INJECTION MATERIALS

- A. Crack Repair System:
 - 1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - 2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
 - 3) Or equal.
 - c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 - f. Product shall be listed in NSF/ANSI 61.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
 - 2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
 - a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
 - c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
 - 3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.3 INSTALLATION

- A. Construction Tolerances: Shall be per ACI 117., except as specified in this Section and elsewhere in the Contract Documents.
- B. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
 - 1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.

3.4 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.
- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
 - 1. Remove by chipping all loose, damaged concrete to sound material.
 - 2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
 - 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.
- C. Repair Material:
 - 1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
 - 2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
 - 3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.5 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 8-inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.
- B. Fill openings less than four inches in their least dimension with Class III non-shrink epoxy grout as specified below.
 - 1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moistureinsensitive, three-component epoxy grouting system.
 - 2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Euco High Strength Grout, by Euclid Chemical Company.
 - b. Sikadur 42, Grout Pak, by Sika Corporation.
 - c. Five Star Epoxy Grout, by Five Star Products, Inc.
 - d. Or equal.
- C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class I non-shrink grout as specified below.
 - 1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
 - 2. Minimum 28-day Compressive Strength: 7,000 psi.
 - 3. Products and Manufacturers: Provide one of the following:

- a. NS Grout by Euclid Chemical Company.
- b. Set Grout by Master Builders, Inc.
- c. NBEC Grout by Five Star Products, Inc.
- d. Or equal.
- D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete as specified below. Proportioning and Design of Class "A" Concrete Mix:
 - 1. Minimum compressive strength at 28 days: 4,000 psi.
 - 2. Maximum water-cement ratio by weight: 0.45.
 - 3. Minimum cement content: 564 pounds per cubic yard, Portland Cement: ASTM C150/C150M, Type I/II.
 - 4. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality. Site soil conditions contain acidic soils.
 - 5. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
 - 6. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.
 - 7. Water: Clean, potable
 - 8. Aggregates: ASTM C33/C33M.
 - a. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
 - b. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter. Crushed stone, processed from natural rock or stone. Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
- E. Where repaired holes are in contact with water or soil, provide hydrophilic rubber waterstop within the opening, prior to filling with repair material.

3.6 REPAIR OF LINED HOLES

- A. This Article applies to openings with embedded material over all or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.5 of this Section, as modified in this Article 3.6.
- B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.
- C. Completely remove embedded items not securely and permanently anchored into concrete.
- D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or

indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.7 REPAIR OF DETERIORATED CONCRETE

- A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.
- B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:
 - 1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.
 - 2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.
 - 3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
 - Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.
- C. Repair Mortar Placing:
 - 1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
 - 2. After initial mixing of repair mortar, addition of water is not allowed.
 - 3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.
 - c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not featherout repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
 - 4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap

between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in any orientation at any location.

- D. Finishing:
 - 1. Provide smooth, steel trowel finish to repair mortar.
 - 2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.8 REPAIR OF EXPOSED REINFORCING

- A. Remove, by abrasive blasting or hydro blasting, all corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.
- C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.
- D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.
- E. For mortar coating, conform to Paragraphs 3.7.C and 3.7.D of this Section.

3.9 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.
- C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to OWNER until structure is watertight.
- D. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.10 SITE QUALITY CONTROL

A. CONTRACTOR shall employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required,

including providing necessary materials for making and facility for storing test specimens. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:

- 1. Necessary assistance required by ENGINEER.
- 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and all other incidentals required, subject to approval by ENGINEER.
- 3. All necessary storage, curing, and transportation required for testing.
- 4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
 - 1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify compliance with the Contract Documents. Specimens will be made by ENGINEER or ENGINEER's representative.
 - 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.
 - 3. Material, already placed, failing to conform to the Contract Documents, is defective.

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SECTION 03 11 00

CONCRETE FORMWORK

<u> PART 1 - GENERAL</u>

1.1 SUMMARY

A. Section includes: Falsework and formwork, as required to construct cast-in-place concrete, including placing of all items such as sleeves, anchor bolts, inserts and all other items to be embedded in concrete for which placement is not specifically provided under other sections.

B. REFERENCES

- 1. American Concrete Institute (ACI)
 - a. ACI 301, Specifications for Structural Concrete for Buildings.
 - b. ACI 347, Guide for Concrete Formwork.

1.2 SYSTEM DESCRIPTION

A. Coordination:

- 1. Review installation procedures under other sections and coordinate the installation of items that must be installed with the formwork.
- 2. Coordinate formwork specifications herein with the requirements for finished surfaces specified in Section 03 30 00, Cast-In-Place Concrete.

1.3 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Submit for information purposes the following: Copies of manufacturer's data and installation instructions for all proprietary materials, including form coatings, manufactured form systems, ties and accessories.
- C. Shop Drawings: Forming, shoring and bracing drawings for footings, walls and roofs.
- D. Calculations: Calculations verifying the selection of form ties, horizontal and vertical stiffbacks or braces for wall panels, forming and form openings, falsework or roof forms, or any other part of forming, shoring or bracing which may be considered critical by the ENGINEER. The drawings, with supporting calculations, must be signed and sealed by a civil or structural engineer registered in the State of Utah.

1.4 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of Section 01 45 00, Quality Control.
- B. Allowable Tolerances: Construct formwork to provide completed concrete surfaces complying with tolerances specified in ACI 347, Chapter 3.3, except as otherwise specified.

C. Furnish and install all items for permanent or temporary facilities in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood overlaid with MDO or HDO specifically designed for concrete forms, metal, metal-framed plywood-faced or other acceptable panel materials, to provide continuous, straight, smooth as-cast surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to remain watertight and withstand pressure of newly placed concrete without bow or deflection.
 - 1. At circular structures, wall forms shall conform to the circular shape of the structure. Straight panels not exceeding 2 feet in horizontal width and installed with angular deflection not greater than 3-1/2 degrees per joint may be substituted for circular forms.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces that will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least 2 edges and 1 side.
- C. Form Ties:
 - 1. Form ties on exposed surfaces shall be located in a uniform pattern or as indicated on the Drawings. Form ties shall be constructed so that the tie remains embedded in the wall, except for a removable portion at each end. Form ties shall have conical or spherical type inserts. Inserts shall be fixed so that they remain in contact with forming material and shall be constructed so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Wire ties will not be permitted. Ties shall withstand all pressures and limit deflection of forms to acceptable limits.
 - 2. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 inch and sufficient dimensions to permit proper patching of the tie hole.
 - 3. Ties for water-holding structures or dry structures with access such as basements, pipe galleries, etc., that are below finish grade, shall have either an integral steel water stop 0.103 inch thick and 0.625 inch in diameter that is tightly and continuously welded to the tie, or a neoprene water stop 3/16 inch thick and 15/16 inch in diameter whose center hole is ½ the diameter of the snap tie, or a molded plastic water stop of comparable size. Flat snap ties complying with above requirements and other sections of this specification may be used. The water stop shall be considerably larger in area than the tie cross sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. The ties shall be constructed to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.
- D. Alternative Form Ties Through-Bolts:
 - 1. Alternate form ties consisting of tapered through-bolts at least 1 inch in diameter at smallest end, or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the CONTRACTOR's option. Clean and roughen, fill, and seal form tie hole as shown on the Drawings; or where not shown on the

Drawings, the CONTRACTOR shall provide a shop drawing submittal of his proposed method of sealing the through-bolt hole by sandblasting or mechanically cleaning and roughening the entire interior surface of the hole, epoxy coating the roughened surface and driving a vinyl plug and then dry packing the entire hole on each side of the plug with non-shrink grout, meeting these Specifications. Dry packing shall be done while the epoxy is tacky or remove the epoxy by mechanical means and reapply new epoxy. The CONTRACTOR shall be responsible for water-tightness and any repair needed. Any leaks or dampness on the exterior of through-bolt patches during or after water testing shall require repair or replacement of the patch.

- 2. The elastic plug to be inserted into the form tie hole as shown on the Drawings shall be a Dayton Sure Plug, or approved equal, sized to allow insertion using the insertion tool to elongate the plug, place it at the correct location, and allow the plug to return to its original length and diameter upon removal to form a watertight seal. The plugs shall be as manufactured and supplied by Dayton Superior, Dayton OH, phone: 888/977-9500.
- E. Forms Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
 - 1. For concrete structures which will be in contact with potable water, the manufacturer shall certify that the form coating used is NSF 61 approved.

2.2 DESIGN OF FORMWORK

- A. The CONTRACTOR shall design all formwork prior to fabrication. The design shall account for all the tolerances, form ties, finishes, architectural features, rebar supports, construction joint locations, and other features and other nonstructural formwork requirements specified. Forms shall contain pouring and observation windows to allow placement of concrete through windows or shall be staged to allow visual observation at all times of the fresh concrete to ensure correct placement and vibration. Provide a formwork and placement design that will limit free fall of concrete in forms 8 inches or less in width to 5 feet; and for forms wider than 8 inches, limit this fall to 8 feet, except as hereinafter specified. Review methods with ENGINEER prior to start of work. Use placement devices, such as chutes, pouring spouts, pumps, as required.
- B. Wall forms shall be designed such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.
- C. Reuse of forms will be permitted only if a "like new" condition, unless otherwise approved in writing, is maintained. The ENGINEER shall be notified 1 full working day prior to concrete placement so that the forms can be inspected. The CONTRACTOR shall correct any defective work, found in the ENGINEER's inspection, prior to delivery of concrete to the project. Formwork surfaces that were in good condition and accepted for use, but were damaged during removal and handling shall not be reused on additional pours. The CONTRACTOR is expected to take care in the handling of forms and to obtain approval of form surfaces prior to each reuse.

- D. Roof forms and falsework supports for structural slabs shall be sufficiently rigid and strong to support the wet concrete and the men and equipment necessary for its placement without appreciable deflections. A minimum of 50 PSF for live load shall be allowed in the design.
- E. All forms, falsework, shoring, and other structural formwork required shall be structurally designed by the CONTRACTOR and the design shall comply with all applicable safety regulations, current OSHA regulations, and other codes. Where federal or state agencies require a licensed engineer to prepare and/or seal all formwork, falsework or shoring designs, the CONTRACTOR shall hire this engineer and pay all costs. The designs shall be made available to any governing agency upon request. Comply with applicable portions of ACI 347, ACI 318 current edition, and theses Specifications. All design, supervision, and construction for safety of property and personnel shall be the CONTRACTOR's full responsibility.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which Work is to be performed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 FORM CONSTRUCTION

- A. Construct forms complying with ACI 347; to the exact sizes, shapes, lines and dimensions shown; as required to obtain accurate alignment, location and grades; to tolerances specified; and to obtain level and plumb work in finish structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes. Finish shall be as determined by approved mock-up or sample panel, if specified.
- B. Fabricate forms for easy removal without damaging concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
- C. Provide temporary form windows where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate form windows on forms in locations as inconspicuous as possible, consistent with requirements of the Work. Form intersecting planes of openings to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.
- D. Falsework:
 - 1. Erect falsework and support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place

concrete structures. Construct falsework so that adjustments can be made for take-up and settlement.

- 2. Provide wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce finished Work of required dimensions.
- E. Forms for Exposed To View Concrete:
 - 1. Do not use metal cover plates for patching holes or defects in forms.
 - 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 - 3. Use extra studs, wales and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
 - 4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
 - 5. Form molding shapes, recesses, rustication joints and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.
- F. Corner Treatment:
 - 1. Form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown. Except as specified below for reentrant or internal corners, exposed corners shall be chamfered.
 - 2. Form chamfers with 3/4"x 3/4" strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Use rigid PVC chamfers for all architecturally formed concrete. Extend terminal edges to require limit and miter chamfer strips at changes in direction.
 - 3. Reentrant or internal corners and unexposed corners need not be formed chamfered.
- G. Openings and Built-In Work:
 - 1. Provide openings in concrete formwork shown or required by other sections or other contracts.
 - 2. Accurately place and securely support items to be built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 FORM COATINGS

- A. Coat form contact surfaces with a non-staining form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into the formwork, anchorage devices and other embedded items, shown, specified or required by other sections and other contracts. Use necessary setting drawings, diagrams, instructions and directions.
- B. Edge Forms and Screeds Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support screeds.

3.5 FIELD QUALITY CONTROL

- A. Before concrete placement, check the formwork, including tolerances, lines, ties, tie cones, and form coatings. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.
- B. During concrete placement check formwork and related supports to ensure that forms are not displaced and that completed Work is within specified tolerances.
- C. If forms are unsatisfactory in any way, either before or during placing of concrete, postpone or stop placement of concrete until the defects have been corrected, and reviewed by ENGINEER.

3.6 REMOVAL OF FORMS

- A. Conform to the requirements of ACI 301, Chapter 2 and ACI 347, Chapter 3.7 except as specified below.
 - Removal of Forms and Supports: Continue curing in accordance with Section 03 30 00, Cast-In-Place Concrete, paragraph 3.6, Concrete Curing and Protection. Forms are to remain in-place for the time specified below following the end of concrete placement. The durations shown represent a cumulative number of days, or hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above or below 50°F.

Temperature:	Above 50	Below 50 degrees F or when retarders are	
	<u>degrees F</u>	used	
Walls	12 hours	48 hours	
Columns	12 hours	48 hours	
Sides of Slabs	6 hours	12 hours	
Structural Floor or Roof	Do not remove forms until site-cured test cylinders develop		
Slabs	100% of 28-days strength.		

- 2. When wall or column forms also support formwork for slab or beam soffits, the removal times of the latter should govern.
- 3. When high-early strength concrete is specified, a schedule for removal of forms will be developed in the field from the age/ strength relationships established for the materials and proportions used by tests in accordance with ACI 301, Section 2.3.4.
- 4. When construction loads are approximately equal to the structural live load, the forms for structural slabs, joists, and beams shall remain in place until the concrete has reached the specified compressive strength.

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B. Leave form-facing material in place a minimum of 4 days after concrete placement, unless otherwise approved by ENGINEER.

3.7 PERMANENT SHORES

A. Provide permanent shores as defined in ACI 347 Chapter 3.7. Re-shores will not be permitted.

3.8 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces. Form surfaces shall be subject to ENGINEER'S approval.

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SECTION 03 15 16

CONCRETE JOINTS

<u> PART 1 - GENERAL</u>

1.1 SUMMARY

A. Section includes installation of concrete joints including, construction joints, expansion joints and fillers, waterstops, and contraction (control) joints.

1.2 REFERENCES

- A. American Concrete Institute (ACI)1. ACI 301, Specifications for Structural Concrete for Buildings.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36, Standard Specification for Structural Steel.
 - 2. ASTM D1752, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 3. ASTM D570, Standard Test Method for Water Absorption of Plastics.
- C. NSF/ANSI Standard 61 Drinking Water Systems Components.

1.3 SYSTEM DESCRIPTION

A. All joints subject to hydrostatic pressure shall be provided with continuous waterstop.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Product Data: Submit for approval, Manufacturer's specifications and installation instructions for all materials required.
- C. Shop Drawings: Submit for approval:
 - 1. Layout of all construction joint locations prior to the submittal of steel reinforcing drawings. The concrete pour sequence and placement schedule shall be stated in the construction joint shop drawing layout.
 - 2. Detail for joining polyvinyl chloride waterstops.
- D. Samples: Submit for approval:
 - 1. Waterstops for joints.
 - 2. Expansion joint fillers.

1.5 QUALITY ASSURANCE

A. Quality control shall be in accordance with the requirements of Section 01 45 00, Quality Control.

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- B. Install all manufactured items in accordance with manufacturer's instructions.
- C. Store materials off the ground and protected from moisture, dirt and other contaminants. Protect installed and uninstalled materials from UV exposure in accordance with manufacturer's instruction.

PART 2 - PRODUCTS

2.1 WATERSTOPS

- A. Polyvinyl Chloride:
 - 1. At potable water facilities, provide NSF-61 Certified PVC waterstops.
 - 2. Reference Standard: ASTM D570.
 - 3. Construction Joints: Minimum of 3/8" thick, ribbed, width as shown, or if not shown, 6-inch minimum, center bulb type may be provided but is not required.
 - 4. Control Joints: Minimum of 3/8" thick, ribbed, center bulb type, width as shown, or if not shown, 6-inch minimum.
 - 5. Expansion Joints: Minimum thickness of 3/8" and 9" minimum width. Provide with "O" or "U" shaped center bulb. The "O" shall have an outside diameter of 3/4" minimum unless shown otherwise.
 - 6. Product and Manufacturer: Provide polyvinyl chloride waterstops of one of the following:
 - a. W.R. Meadows
 - b. Sika Greenstreak
 - c. Or approved equal
- B. Hydrophilic:
 - 1. Provide chloroprene rubber waterstops, 3/8-inch thick.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sika Hydrotite.
 - b. Or approved equal.
- C. Retrofit Waterstop:
 - 1. Polyvinyl chloride or thermoplastic vulcanizate waterstop used between existing concrete and new concrete: Minimum of 3/8-inch thick, ribbed, 4-inch nominal width, 3-inch minimum height, T or L shaped.
 - 2. Provide epoxy gel bed below retrofit waterstop.
 - 3. Attach waterstop to existing concrete with stainless steel expansion anchors or concrete screws and stainless-steel batten bar with minimum dimensions of 1 ¹/₂- inch by 3/16-inch.
 - 4. Product and Manufacturer: Provide one of the following:
 - a. Sika Greenstreak 581.
 - b. Earth Shield JP 320L.
 - c. Or approved equal.

2.2 PREFORMED EXPANSION JOINT FILLER

A. Bituminous type conforming to ASTM D994 or D1751, unless otherwise shown or specified.

2.3 CONCRETE CONSTRUCTION JOINT ROUGHENER

- A. Provide a water-soluble non-flammable, surface-retardant roughener.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Rugasol-S, as manufactured by Sika Corporation for horizontal joints.
 - 2. MBT EAC-S, as manufactured by Master Builders for horizontal joints.
 - 3. MBT Tuf-Cote (Deep Etch), as manufactured by Master Builders for vertical joints.
 - 4. Or approved equal.

2.4 EPOXY BONDING AGENT

- A. Provide an epoxy-resin bonding agent, two component type.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Sikadur 32 Hi-Mod LPL, as manufactured by Sika Corporation.
 - 2. Dural LPL, as manufactured by the Euclid Chemical Company.
 - 3. Epoxtite Binder (Code # 2390), as manufactured by A.C. Horn, Incorporated.
 - 4. Or approved equal.

2.5 RUBBER BONDING AGENT

- A. Product and Manufacturer: Provide one of the following:
 - 1. Scotch-Grip 1300 Rubber Adhesive, as manufactured by 3M Company.
 - 2. Or approved equal.

2.6 MORTAR

A. Mortar must be composed of cement, sand and water. Materials for mortar must comply with Section 03 30 00, Cast-In-Place Concrete. The proportion of sand to cement measured by volume must be 2 to 1, respectively. Mortar must contain only enough water to allow placing.

2.7 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape, same width as joint that will adhere to pre-molded joint material or concrete surface.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrate and conditions under which Work is to be performed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- 3.2 CONSTRUCTION JOINTS
 - A. Comply with ACI 301, Chapter 2.2, and as specified below.

- B. Locate and install construction joints as shown. Locate additional construction joints as required to satisfactorily complete all Work.
- C. Horizontal Joints:
 - 1. Roughen concrete at the interface of construction joints by sandblasting to expose the aggregate (1/4-inch minimum amplitude) and remove accumulated concrete on rebar immediately subsequent to form stripping. When sandblasting adjacent to installed waterstops, shield installed waterstops from the sandblasting operation. Immediately before placing fresh concrete, thoroughly clean the existing contact surface using a stiff brush or other tools and a stream of water under pressure. The surface shall be clean and wet, but free from pools of water at the moment the fresh concrete is placed.
 - 2. Remove laitance, waste mortar or other substance that may prevent complete adhesion.
 - 3. At the base of walls with waterstops, place a 3" thick coat of mortar over the surface of the old concrete. Place fresh concrete before the mortar has attained its initial set.
- D. Vertical Joints:
 - 1. Remove accumulated concrete on rebar.
 - 2. Roughen concrete at the interface of the construction joints to expose the aggregate (1/4-inch minimum amplitude) through one of the following:
 - a. Apply roughener to the form in a thin, even film by brush, spray or roller in accordance with the manufacturer's instructions. After roughener is dry, concrete may be placed. When concrete has been placed and the form removed, wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER.
 - b. Sandblast after concrete has fully cured.
 - c. Waterblast after concrete has partially cured.
 - d. Perform cleaning so as not to damage waterstop, if one is present.

3.3 WATERSTOPS

- A. General:
 - 1. Comply with ACI 301, Chapter 2, and as specified below. Make all joints in accordance with manufacturer's instructions.
 - 2. Obtain ENGINEER'S approval for waterstop locations not shown.
 - 3. Provide waterstops in all basements, tanks and other substructures up to an elevation at least 12" above grade or to an elevation at least 12" above highest liquid level in tanks, whichever is higher, except where otherwise shown or noted.
- B. Polyvinyl Chloride Waterstop:
 - 1. Tie waterstops to reinforcing steel at 12-inches on center, in each direction, so that it is securely and rigidly supported in the proper position, centered in the joint, during concrete placement. Hog rings shall be used to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.
 - 2. Continuously inspect waterstops during concrete placement to ensure their proper positioning.
 - 3. Provide fused waterstops using equipment as supplied by or recommended by the manufacturer. Joints shall be inspected for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop and shall be watertight.

- 4. Cover and protect installed waterstops from UV if the pour of concrete will be delayed more than 30 days.
- 5. Shield installed waterstops from sandblasting when performing surface roughening adjacent to installed waterstops.
- C. Hydrophilic Waterstop: Install where shown in accordance with manufacturer's recommendations.

3.4 BONDING WITH EPOXY ADHESIVE

- A. Use adhesive for the following:
 - 1. Bonding of fresh concrete to concrete cured at least 45 days or to existing concrete.
 - 2. Bonding of horizontal surfaces, which will receive a topping.
- B. Handle and store epoxy adhesive in compliance with the manufacturer's printed instructions, including safety precautions.
- C. Mix the epoxy adhesive in complete accordance with the instructions of the manufacturer.
- D. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy adhesive not less than 1/16" thick. Place fresh concrete while the epoxy material is still tacky, without removing the in-place grout coat, and as directed by the epoxy manufacturer.

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Fabrication and placement of reinforcement including bars, ties and supports, and welded wire fabric for concrete, encasements and fireproofing.

1.2 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Shop Drawings:
 - 1. Manufacturer's specifications and installation instructions for all materials and reinforcement accessories.
 - 2. Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, Parts A and B. For walls, show elevations to a minimum scale of 1/4 inch to 1 foot. For slabs, show top and bottom reinforcing on separate plan views. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement, unless otherwise noted. Keep splices to a minimum. Avoid splices in regions of maximum tension stresses whenever possible.
- C. Certificates: Submit one (1) copy of steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel per lot of steel used.

1.3 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of Section 01 45 00, Quality Control.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. American Concrete Institute (ACI):
 - a. ACI 315, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - b. ACI 318, Building Code Requirements for Reinforced Concrete.
 - 2. Concrete Reinforcing Steel Institute:
 - a. Manual of Standard Practice, includes ASTM standards referred to herein.
- C. Allowable Placing Tolerances: Comply with ACI 318, Chapter 7 Details of Reinforcement.

1.4 DELIVERY, HANDLING AND STORAGE

- A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust. Store on heavy wood blocking so that no part of it will come in contact with the ground.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60 for all non-welded bars. ASTM A706, Grade 60 for welded bars.
- B. Smooth Steel Dowels: ASTM A36.1. Epoxy coated conforming to ASTM A775 or ASTM A934.
- C. Mechanical Couplers: Reinforcement bars may be spliced with a mechanical connection. Provide a full mechanical connection which shall develop in tension or compression, as required, at least 125% of specified yield strength (f_y) of the bar in accordance with ACI 318 Section 12.14.3.2. The locations of the connections are subject to the approval of the ENGINEER.
 - 1. Dayton Superior Bar Lock S/CA Series.
 - 2. Or approved equal
- D. Threaded Splicing Systems: Dowel Bar Splicer System shall comply with ICC Report #4028. The completed splice shall exceed 160% of the specified yield strength (f_y) of the bar.
 - 1. Dayton Superior DB/DI parallel threaded couplers.
 - 2. Or approved equal
- E. Steel Wire: ASTM A82.
- F. Welded Wire Fabric: ASTM A185. Furnish in flat sheets, not rolls.
- G. Column Spirals: Hot-rolled rods for spirals, ASTM A615.
- H. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
 - 1. Use wire bar type supports complying with CRSI recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
 - 2. For slabs on grade, use 5000 psi concrete blocks.
 - 3. At all formed surfaces, provide supports complying with CRSI "Manual of Standard Practice" as follows: Plastic protected or stainless steel legs.
 - 4. For all PVC lined concrete surfaces, provide supports complying with CRSI "Manual of Standard Practice" as follows: Either plastic or metal plastic protected legs.

2.2 FABRICATION

- A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI, "Manual of Standard Practice". In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.
- B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:
 - 1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
 - 2. Bends or kinks not shown on approved shop drawings.
 - 3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which concrete reinforcement is to be placed with installer, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. Comply with the applicable recommendations of specified codes and standards, and CRSI, Manual of Standard Practice, for details and methods of reinforcement placement and supports.
- B. Clean reinforcement to remove loose rust and mill scale, oil, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
 - 1. Place reinforcement to obtain the minimum concrete cover as shown. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcement accurately in position during concrete placement operations. Slab and wall bars shall be tied at every intersection around the periphery of the slab or wall and not less than every 48 inches in the field at walls and 60 inches in the field at slabs.
 - 2. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete.
 - 3. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 - 4. Do not secure reinforcing steel to forms with wire, nails or other ferrous metal. Do not permit metal supports subject to corrosion to touch or be within the required clearance to formed or exposed concrete surfaces.
- D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Do not make end laps midway between

supporting beams or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

- E. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2-inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment or similar construction loads.
- F. Splices: Provide reinforcement lap splices by placing bars in contact and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars.
- G. Mechanical Couplers in Lieu of Lap Splicing:
 - 1. Provide mechanical butt splices in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Flame dry bars before butt splicing. Provide adequate jigs and clamps or other devices to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.
- H. Reinforcement Around Openings: Place an equivalent area of steel around the pipe or opening and extend on each side sufficiently to develop bond in each bar. See the Details on Drawings for bar extension length each side of opening. Where welded wire fabric is used, provide extra reinforcing using fabric or deformed bars.
- I. Field Bending: Field bending of reinforcing steel bars is not permitted when rebending will later be required to straighten bars. Rebending of bars at the same place where strain hardening has taken place due to the original bend will damage the bar. Consult with the ENGINEER prior to any pour if the CONTRACTOR foresees a need to work out a solution to prevent field bending.

3.3 INSPECTION OF REINFORCEMENT

A. Do not place concrete until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

+ + END OF SECTION + +

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

<u> PART 1 - GENERAL</u>

1.1 SUMMARY

A. Section includes: Place, finish, cure, strip, and repair concrete.

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 - 2. ACI 214, Recommended Practice for Evaluation of Strength Test Results of Concrete.
 - 3. ACI 301, Specifications for Structural Concrete for Buildings, (includes ASTM Standards referred to herein).
 - 4. ACI 304, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 5. ACI 305, Hot Weather Concreting.
 - 6. ACI 306, Cold Weather Concreting.
 - 7. ACI 309, Guide for Consolidation of Concrete.
 - 8. ACI 311, Guide for Concrete Inspection.
 - 9. ACI 318, Building Code Requirements for Reinforced Concrete.
 - 10. ACI 347, Guide to Formwork for Concrete
 - 11. ACI 350, Environmental Engineering Concrete Structures.

1.3 SYSTEM DESCRIPTION

- A. Class A Concrete shall be steel reinforced and includes:
 - 1. Foundations.
 - 2. Walls.
 - 3. Slabs.
 - 4. Beams.
 - 5. Girders.
 - 6. Columns.
 - 7. Equipment bases.
 - 8. Pipe supports.
- B. Class B Concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes:
 - 1. Concrete fill.
 - 2. Curbs and gutters.
 - 3. Sidewalks.
 - 4. Thrust blocks.
 - 5. Encasements.

1.4 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Samples: Submit samples of materials as specified and as otherwise may be requested by ENGINEER, including names, sources and descriptions.
- C. Product Data: Submit for approval the following:
 - 1. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 - List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs.
- D. Laboratory Test Reports: Submit copies of laboratory test reports for materials and mix design tests
- E. Delivery Tickets: Furnish to ENGINEER copies of all weighmaster certificate delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C94, Section 16. Delivery tickets shall be signed by a Certified Weighmaster.

1.5 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of Section 01 45 00, Quality Control.
- B. Tests for Concrete Materials: Submit written reports to ENGINEER, for each material sampled and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.
- C. If the concrete mix designs specified herein have not been used previously by the ready-mix SUPPLIER, mix proportions and concrete strength curves for regular cylinder tests shall be established by an approved ready-mix SUPPLIER or an independent testing laboratory based on the relationship of 7, 14 and 28 day strengths versus slump values of 2, 4 and 6 inches, all conforming to these Specifications. A laboratory, independent of the ready-mix SUPPLIER, shall be required to prepare and test all concrete cylinders. The costs for preparation of mix designs, not previously used by the ready-mix SUPPLIER, and testing of concrete and materials shall be borne by CONTRACTOR.

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PART 2 - PRODUCTS

- 2.1 CONCRETE MATERIALS
 - A. Cement:

- 1. Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type 1P (MS).
- 2. Do not use cement which has deteriorated because of improper storage or handling.
- B. Aggregates: ASTM C33 and as herein specified.
 - 1. Do not use aggregates containing soluble salts, substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
 - 2. Fine Aggregate: Provide clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
 - 3. Coarse Aggregate: Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Coarse Aggregate Size: Size to be ASTM C33, Nos. 57 or 67, except that No. 467 may be used for footings, foundation mats and walls 16 inches or greater in thickness.
- C. Water: Clean, free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel.

2.2 CONCRETE ADMIXTURES

- A. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instruction. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER.
- B. Air-Entraining Admixtures: ASTM C260.
 - 1. Product and Manufacturer: Provide one of the following:
 - a. SIKA AER, as manufactured by Sika Corporation.
 - b. MasterAir AE 200, as manufactured by BASF.
 - c. Daravair, as manufactured by W.R. Grace & Co.-Conn.
 - d. Or approved equal.
- C. High-Range Water-Reducing Admixture ("Superplasticizer"): ASTM C494, Type F/G.
 - 1. Superplasticizer shall be used in all Class A Concrete. Do not use high range water-reducing admixture containing more chloride ions than are contained in municipal drinking water. Add only at the job site to concrete in compliance with the manufacturer's printed instruction.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sikament 320, as manufactured by Sika Corporation.
 - b. MasterGlenium, as manufactured by BASF.
 - c. Daracem-100, as manufactured by W.R. Grace & Co.-Conn.
 - d. Or approved equal.
- D. Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. A water-reducing, aqueous solution of a modification of the salt of polyhydroxylated organic acids. Do not use admixture containing any lignin, nitrates or chlorides added during manufacture.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Eucon WR-75, as manufactured by The Euclid Chemical Company.
 - b. MasterPozzolith, as manufactured by BASF.

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- c. WRDA series, as manufactured by W.R. Grace & Co.-Conn.
- d. Or approved equal.
- E. Pozzolanic Admixtures:
 - 1. Pozzolanic admixtures shall not be used in structures with concrete in contact with potable water, but may be used in other concrete.
 - 2. Provide Mineral admixtures, when used, meeting the requirements of ASTM C618 Class F.
 - 3. A substitution by weight, of the portland cement by pozzolan, so that the total tricalcium aluminate content of the resulting cement plus pozzolan is not greater than 8%, will be considered. However, the pozzolan shall not exceed 20% by weight of the cement plus pozzolan.
- F. Set-Control Admixtures: ASTM C494, as follows:
 - 1. Type B, Retarding.
 - 2. Type C, Accelerating.
 - 3. Type D, Water-reducing and Retarding.
 - 4. Type E, Water-reducing and Accelerating.
 - 5. Type F, Water-reducing, high range admixtures.
 - 6. Type G, Water-reducing, high range, and retarding admixtures.
- G. Color Pigments:
 - 1. Color pigments for colored concrete must be of iron oxides complying with ASTM C979.
- H. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by ENGINEER. Do not use admixtures containing calcium chloride where concrete is placed against galvanized steel.

2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes of concrete. Mixes subject to the following limitations:
 - 1. Class A Concrete
 - a. Specified 28-day Compressive Strength: 4,000 psi minimum.
 - b. Air content: $5\% \pm 1\%$. For concrete placed at least 2 feet below the adjacent grade, an air-entraining admixture is not required unless otherwise specified.
 - c. Slump, before addition of superplasticizer: 3-1/2 inches $\pm 1/2$ inch
 - d. Slump, after addition of superplasticizer: 8 inches maximum

Coarse	Cementitious	Water-Cement
Aggregate	Content-Pounds Per	Ratio by Weight
Size	Cubic Yard	
3⁄4″	625 min, 800 max	0.375
1″	600 min, 800 max	0.385
1 1/2″	590 min, 800 max	0.400

- e. Use superplasticizer in all Class A Concrete. Use water reducers in combination with superplasticizers as required for mixing.
- 2. Class B Concrete
 - a. Specified 28-day Compressive Strength: 4,000 psi.
 - b. Maximum Water-Cement Ratio by Weight: 0.44.
 - c. Air Content: 5 percent ±1 percent.

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- d. Slump: 3 inches minimum, 5 inches maximum.
- B. Use an independent testing facility acceptable to ENGINEER for preparing and reporting proposed mix designs.
- C. Admixtures:
 - 1. Use air-entraining admixture in all concrete, except interior slabs subject to abrasion, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the prescribed limits.
 - 2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.
- D. Colored Concrete:
 - 1. The dosage of colored pigments for colored concrete must not exceed 10 percent by weight of cementitious materials in the concrete mix design.
 - 2. When test panels are specified, cementitious materials and aggregates from the same sources used in the authorized test panel must be used for the colored concrete in the completed work.

2.4 EPOXY BONDING AGENT

- A. For use in all dry-packed holes, concrete repair and for unplanned cold-joints.
- B. Provide an epoxy-resin bonding agent, two component, polysulfide type.
- C. Product and Manufacturer: Provide one of the following:
 - 1. Sikadur 32, Hi-Mod LPL, as manufactured by Sika Corporation.
 - 2. Eucopoxy LPL, as manufactured by the Euclid Chemical Company.
 - 3. Or approved equal.

2.5 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M182, Class 3.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap-polyethylene sheet.
- C. Curing Compound: ASTM C309 Type 1-D (water retention requirements):
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Super Aqua Cure VOX, as manufactured by The Euclid Chemical Company.
 - b. Sealtight 1100, as manufactured by W.R. Meadows, Incorporated.

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- c. Or approved equal.
- D. Concrete Densifier and Chemical Hardener (Surface Applied)
 - 1. Product and Manufacturer: Provide one of the following:
 - a. LS, as manufactured by Consolideck.
 - b. Liqui-Hard, as manufactured by W. R. Meadows.

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- c. Duro-Nox LS, as manufactured by Nox-Crete.
- d. Or approved equal.

2.6 EMBEDDED ITEMS

- A. Provide and install items such as plates, angles, inserts, bolts and similar items not specified elsewhere under this Section. Carbon steel embedded items shall be hot dip galvanized after fabrication.
- B. Abrasive Stair Nosings
 - 1. Provide single-component stair nosing
 - 2. 3-inch width
 - 3. Aluminum Extrusion, with provisions for anchoring into concrete
 - 4. Extruded with multiple channels, dovetail shaped, filled with aluminum oxide grit set in epoxy resin
 - 5. Designed for installation before concrete sets, at the front edge of the stair
 - 6. Provide continuous stair nosings, width of stairway less 3 inches on each side. No splices in stair nosings.
 - 7. Manufacturers/Models:
 - a. Balco; Model R-315P
 - b. Babcock Davis; Model BSTTB
 - c. Or Equal

PART 3 - EXECUTION

3.1 CONCRETE MIXING

- A. Provide concrete produced by the ready-mixed process.
- B. Comply with the requirements of ASTM C 94, and as herein specified. Proposed changes in mixing procedures, other than herein specified, must be accepted by ENGINEER before implementation.
 - 1. Plant equipment and facilities: Conform to National Ready- Mix Concrete Association "Plant and Delivery Equipment Specification."
 - 2. Mix concrete in revolving type truck mixers that are in good condition and which produce thoroughly mixed concrete of the specified consistency and strength.
 - 3. Do not exceed the proper capacity of the mixer.
 - 4. Mix concrete for a minimum of two minutes after arrival at the job site, or as recommended by the mixer manufacturer.
 - 5. Mix concrete during transit only as recommended by the mixer manufacturer.
 - 6. Mix at proper speed until concrete is discharged.
 - 7. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
 - 8. Provide access to the mixing plant for ENGINEER at all times.

3.2 TRANSPORTING CONCRETE

A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients or before 250 revolutions of the drum or blades, whichever occurs first.

- B. If an admixture is used to retard the set time and the concrete temperature does not exceed 85 degrees F, the travel and placing time may be extended to 120 minutes or 300 revolutions of the drum or blades, whichever occurs first.
- C. Take care to avoid spilling and separation of the mixture during transportation.
- D. Do not place concrete in which the ingredients have been separated.
- E. Do not re-temper partially set concrete.
- F. Use suitable and approved equipment for transporting concrete from mixer to forms.

3.3 CONCRETE PLACEMENT

- A. General: Place concrete continuously so that no concrete will be placed on concrete, which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified in Section 03 15 16, Concrete Joints. Deposit concrete as nearly as practical in its final location to avoid segregation due to re-handling or flowing. Do not subject concrete to any procedure that will cause segregation.
 - 1. Screed concrete that is to receive other construction to the proper level to avoid excessive skimming or grouting.
 - 2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
 - 3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.
 - 4. Do not place in cold weather, unless adequate precautions are taken against frost action.
 - 5. Do not place footings, piers or pile caps on frozen soil.
 - 6. Unless otherwise approved, place concrete only when ENGINEER is present.
 - 7. Allow a minimum of 3 days of curing before placing new concrete against a slab or wall already in place.
- B. Concrete Conveying:
 - 1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods that will prevent segregation and loss of concrete mix materials.
 - 2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, ice and other deleterious materials.
 - 3. Pumping concrete is permitted, however do not use aluminum pipe for conveying.
- C. Placing Concrete into Forms:
 - 1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete that is being integrated with fresh concrete is still plastic.

- 2. Do not permit concrete to free fall within the form from a distance exceeding 8 feet, 0 inches, except as noted in Section 03 11 00, Concrete Formwork. Use "elephant trunks" or "wall pipes" to prevent free fall and excessive splashing on forms and reinforcement.
- 3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
- 4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the applicable recommended practices of ACI 309. Vibration of forms and reinforcing will not be permitted.
- 5. Vibrators shall have a frequency of at least 8,000 vibrations per minute, with amplitude required to consolidate the concrete in the section being placed. <u>At least one stand-by vibrator</u> in operable condition shall be at the placement site prior to initiating placement of the concrete.
- 6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
- 7. The forms shall contain sufficient windows or be limited in height to allow visual observation of the concrete and the vibrator operators shall be required to see the concrete being consolidated to ensure good quality workmanship or the CONTRACTOR shall have a person who is actually observing the vibration of the concrete at all times and advising the vibrator operators of any changes needed to assure complete consolidation.
- 8. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
- 9. Force concrete under pipes, sleeves, openings and inserts from one side until visible from the other side to prevent voids.
- D. Placing Concrete Slabs and Footings:
 - 1. Deposit and consolidate concrete in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
 - 2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures.
 - 4. Bring surfaces to the correct level. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the surfaces prior to beginning finishing operations.
- E. Bonding for Next Concrete Pour: Per Section 03 15 16, Concrete Joints.
- F. Quality of Concrete Work:
 - 1. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.

- 2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- 3. Cut out and properly replace to the extent ordered by ENGINEER, or repair to the satisfaction of ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering will not be acceptable.
- 4. Repair all leaks through concrete, and cracks, holes or other defective concrete in areas of potential leakage and make watertight.
- 5. Repair, remove, and replace defective concrete as ordered by ENGINEER at no additional cost to OWNER.
- G. Cold Weather Placing:
 - 1. Protect all concrete Work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
 - 2. When the air temperature has fallen to or may be expected to fall below 40°F, provide adequate means to maintain the temperature, in the area where concrete is being placed, at between 50 degrees F and 70 degrees F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain the heat and protection, if necessary, to ensure that the ambient temperature does not fall more than 30 degrees F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
 - 3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55 degrees F and not more than 85 degrees F at point of placement.
 - 4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost and ice before placing concrete.
 - 5. When temperatures are expected to be below 32 degrees F the night before the concrete is placed, then all reinforcing steel, forms and the ground shall be preheated, for a minimum of 12 hours, under a minimum temperature of 50 degrees F.
 - 6. Do not use salt and other materials containing antifreeze agents or chemical accelerators, or set-control admixtures, unless approved by ENGINEER, in mix designs.
 - 7. Weather predictions made by the nearest NOAA station, and corrected for the local elevation and environmental conditions, may be used to determine whether cold weather protection shall be required. Thermometers will be used by ENGINEER and these readings shall determine whether cold weather protection shall be required and whether cold weather protection is adequate.
- H. Hot Weather Placing:
 - 1. When hot weather conditions exist as any combination of high air temperature, low relative humidity and wind velocity that would seriously impair the quality and strength of concrete, place concrete as recommended by ACI 305 and as herein specified.
 - Cool ingredients before mixing to maintain concrete temperature at time of placement below 85 degrees F. No concrete shall be placed if its temperature exceeds 90 degrees F. Mixing water may be chilled, or chopped ice may be used, or liquid nitrogen may be added. Ice, when introduced into the mixer shall be in

such form that it will be completely melted and dispersed throughout the mix at the completion of the mixing time. The addition of ice shall not increase the specified water to cement ratio.

- 3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- 4. Thoroughly wet forms before placing concrete. Forms shall be free of standing water when concrete is placed.
- 5. Do not use set-control admixtures, unless approved by ENGINEER in mix designs.
- 6. Fog spray shall be used during finishing operations whenever necessary to avoid surface plastic shrinkage cracking. Fog spray shall also be used after finishing and before the specified curing is commenced to avoid surface plastic shrinkage cracking.
- 7. Obtain ENGINEER'S approval of other methods and materials proposed for use.
- I. Removal of Forms:
 - 1. The CONTRACTOR shall be responsible for all damage resulting from improper and premature removal of forms. Satisfy all applicable OSHA requirements with regard to safety of personnel and property.
 - 2. Forms and shoring for elevated structural slabs or beams shall remain in place in accordance with ACI 318, Chapter 6, and until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders unless noted otherwise in Section 03 11 00, Concrete Formwork. Removal of all supports prior to obtaining adequate field cured cylinder results and reshoring shall not be permitted.
- J. Backfill Against Walls:
 - 1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, the backfill shall be placed simultaneously on both sides to prevent differential pressures.
 - 2. Since the walls of some structures are laterally restrained or supported by suspended slabs and/or slabs on grade and are not designed as cantilever retaining walls, the CONTRACTOR shall submit a schedule of wall shoring, bracing, and backfilling that is coordinated with the concrete curing, test cylinder reports and the design assumptions and obtain a review from the ENGINEER prior to proceeding.
- K. Patching:
 - 1. Patching of concrete shall provide an acceptable and structurally sound surface finish uniform in appearance or the CONTRACTOR shall upgrade the finish by other means at no additional cost.
 - 2. Tie Holes: All tie holes, except where sealant is indicated, shall be filled with dry pack nonshrink grout. White cement shall be added as needed so the color of grout after curing matches the color of adjacent concrete. Tie holes shall be thoroughly sandblasted or roughened. Flush the patch area with water and allow to dry. Coat the surface of the existing concrete with an approved bonding agent prior to filling with nonshrink grout. Complete the repair in the time duration specified by the bonding agent manufacturer. The grout shall be rammed into place in thin layers and leveled to the plane of the surrounding concrete. Cure in accordance with the manufacturer's recommendations.
 - 3. Defective Areas: Remove all defective concrete such as honeycombed areas and rock pockets out to sound concrete. Small shallow holes caused by air entrapment

at the surface of the forms shall not be considered defects unless the amount is so great as to be considered not the standard of the industry and due primarily of poor workmanship. If chipping is required, the edges shall be perpendicular to the surface. Feather edges shall not be permitted. The defective area shall be filled with a nonshrink, nonmetallic, grout. Use an approved bonding agent on horizontal patches prior to placing nonmetallic, non shrink grout. Since some bonding agents may not be compatible for some vertical surface patching techniques, demonstrate all methods for repair of vertical surfaces using the actual materials, methods, and curing procedures required by the manufactures of the materials on the project site. The CONTRACTOR shall consult with representatives of the bonding agent manufacturer and the nonshrink grout manufacturer, and these representatives shall be onsite and assist in the demonstration.

4. Blockouts at Pipes or Other Penetrations: Conform to details shown or submit proposed blockouts for review. Use nonshrink, nonmetallic grout.

3.4 FINISH OF FORMED SURFACES

- A. Rough Form Finish:
 - 1. Standard rough form finish is with concrete surface having the texture imparted by the form material, with tie holes and defective areas repaired and patched with mortar of 1 part cement to 1-1/2 parts sand & all fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.
 - 2. Use rough form finish for the following:
 - a. Exterior vertical surfaces up to 1 foot below grade.
 - b. Interior exposed vertical surfaces of liquid containers up to 1 foot below liquid level.
 - c. Interior and exterior exposed beams and undersides of slabs.
 - d. Other areas shown.
- B. Smooth Form Finish:
 - 1. Produce smooth form finish (Class A, as defined by ACI-347) by selecting form materials that will impart a smooth, hard, uniform texture. Arrange panels in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as above with all fins or other projections completely removed and smoothed.
 - 2. Use smooth form finish for surfaces that are to be covered with a coating material. The material may be applied directly to the concrete or may be a covering bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.
- C. Smooth Rubbed Finish:
 - 1. Provide smooth, rubbed finish to concrete surfaces which have received smooth form finish as follows:
 - a. Rubbing of concrete surfaces not later than the day after form removal.
 - b. Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
 - 2. Except where surfaces have been previously covered as specified above, use smooth rubbed finish for the following:
 - a. Interior exposed walls and other vertical surfaces.
 - b. Exterior exposed walls and other vertical surfaces down to 1 foot below grade.

- c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
- d. Interior exposed vertical surfaces of liquid containers down to 1 foot below liquid level.
- e. Other areas shown.
- D. Sack Rubbed Finish:
 - 1. Before applying the sack-rubbed finish, fill all tie rod holes and large cavities and remove or correct all fins and irregularities as specified in the Smooth Rubbed Finish.
 - 2. Produce a sack rubbed finish by rubbing the concrete surface with a clean rubber float or wad of burlap and mortar. Use mortar made of premixed sacking mortar or one part portland cement and 1.5 parts, by volume, clean sand passing a No. 16 sieve, mixed with sufficient water to provide a consistency equal to that of a thick cream. Use the same type and brand cement as used in the concrete or colored premixed sacking mortar. The mortar finish color shall match the surrounding concrete. If necessary, blend white cement into the mortar to match the surrounding concrete surface.
 - 3. Thoroughly wet the surface of the concrete and then perform sack rubbing while the surface is damp but not wet. Thoroughly rub the mortar over the area with a rubber float or wad of burlap, filling all pits. While the mortar is still plastic in the pits, rub the surface with the rubber float or burlap using a dry mix of the above proportions, removing all excess plastic material and placing enough dry material in the pits to stiffen and solidify the mortar, then finish the mortar fillings flush with the surface. At the end of the rubbing, no mortar or material shall remain on the surface other than that within the pits.
 - 4. Ensure the completed surface is free of surface voids and blemishes, and is uniform in appearance and texture, except for the difference in texture between the filled voids and the remainder of the surface.
 - 5. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application.
 - 6. Use a sack rubbed finish for the following areas or as indicated in the Drawings: a. Interior exposed walls and other vertical surfaces.
 - b. Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
 - c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
 - d. Or other areas shown.
- E. Related Unformed Surfaces:
 - 1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.5 MONOLITHIC SLAB FINISHES

- A. Float Finish:
 - 1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Check and level the surface plane to a tolerance not exceeding

1/4-inch in 10 feet when tested with a 10-foot straightedge. Cut down high spots and fill all low spots. Uniformly slope surface to drains as shown. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

- 2. Use float finish for the following:
 - a. Interior horizontal surfaces of liquid containers, except those to receive grout topping.
 - b. Exterior below grade horizontal surfaces.
 - c. Surfaces to receive additional finishes, except as shown or specified.
- B. Trowel Finish:
 - 1. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
 - 2. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straight edge. Grind smooth surface defects that would telegraph through applied floor covering system.
 - 3. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or specified.
 - b. Slabs to receive resilient floor finishes.
- C. Non-Slip Broom Finish:
 - 1. Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom, unless otherwise directed. Coordinate the required final finish with ENGINEER before application.
 - 2. Use Non-Slip Broom Finish for the following:
 - a. Exterior exposed horizontal surfaces subject to light foot traffic.
 - b. Interior and exterior concrete steps and ramps.
 - c. Horizontal surfaces which will receive a grout topping or a concrete equipment base slab.

3.6 CONCRETE CURING AND PROTECTION

- A. General:
 - 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
 - 2. Start initial curing after placing and finishing concrete as soon as free moisture and bleed water sheen has disappeared from the concrete surface. Keep concrete continuously moist during initial curing.
 - Begin final curing procedures immediately following initial curing and before the concrete has dried. The total curing duration shall not be less than ten (10) days. For concrete sections over 30 inches thick, continue curing for an additional seven (7) days, minimum. Avoid rapid drying at the end of the final curing period.
- B. Use one of the following methods as approved by ENGINEER:
 - 1. Walls:
 - a. Method 1: Leave concrete forms in place and keep entire surfaces of forms and exposed concrete surfaces wet for the entire curing duration. If forms are

loosened and the contact between the concrete surface and forms is broken, then the entire wall shall be wet cured.

- b. Method 2: Continuously sprinkle or fog with water 100 percent of the exposed surfaces for the curing duration immediately after removal of forms.
- c. Method 3: When approved by ENGINEER and as noted below, apply curing compound immediately after removal of forms.
- 2. Slab and Curbs:
 - a. Method 1: Protect surface by water ponding for the entire curing duration.
 - b. Method 2: Cover concrete surfaces and exposed edges with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet with sprinklers or porous hoses during the curing duration. Lap adjacent absorptive cover sections 3-inches minimum.
 - c. Method 3: Cover the concrete surfaces and exposed edges with the specified moisture-retaining cover during the curing duration. Seal edges and seams with waterproof tape, adhesive or sand berm. Water must be introduced between the moisture-retaining cover and the concrete surface whenever moist drops cannot be detected on the concrete side of the cover or the concrete surface is noticeably dry.
 - d. Method 4: Cover all exposed surfaces with 1-inch minimum layer of wet sand, earth, or sawdust and keep continuously wet for the curing duration.
 - e. Method 5: Continuously sprinkle or fog exposed surfaces for the curing duration.
 - f. Method 6: When approved by ENGINEER and as noted below, apply liquid curing compound immediately after final finishing when surface will no longer be damaged by traffic necessary to apply curing compound.
- C. Liquid curing compound:
 - 1. Apply the specified curing compound to concrete surfaces when permitted by ENGINEER. Slabs to receive terrazzo floors, concrete/grout topping or ceramic tile, concrete of water bearing structures, and concrete that will receive coatings shall not be cured with liquid curing compound. The compounds shall be applied by power spray equipment in accordance with the manufacturer's directions. Recoat areas, which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Remove curing compound from exposed surfaces at the end of the curing duration. For concrete surfaces, which will be in contact with potable water, the manufacturer shall certify that the curing compound used is NSF 61 approved.
- D. Temperature of Concrete During Curing:
 - 1. When the nighttime low temperature may drop to 40 degrees F or below, maintain the concrete temperature between 50 degrees F and 70 degrees F continuously throughout the curing period, by heating, covering, insulation or housing as required.
 - 2. When the daytime high temperature may rise to 90 degrees F or above, maintain the concrete temperature at a minimum and reduce temperature variations by providing moist curing continuously for the concrete curing period.
 - 3. During either of the conditions specified above, the minimum curing time shall be 10 days (240 hours), after which coverings, housings, and insulation shall remain on the work for an additional 3 days, to allow gradual temperature equalization with the atmosphere.

E. Protection from Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.7 FIELD QUALITY CONTROL

- A. The CONTRACTOR will employ a testing laboratory to perform field quality control testing. ENGINEER will direct the number of tests and cylinders required. Furnish all necessary assistance required by ENGINEER.
- B. Quality Control Testing During Construction:
 - 1. Perform sampling and testing for field quality control during the placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
 - c. Air Content: ASTM C231; one for the first concrete load, and one for every two concrete loads thereafter, or when required by an indication of change. Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
 - d. Compressive Strength Tests: ASTM C39; one set of 4 standard compression cylinders for each 100 cubic yards or fraction thereof, of each mix design placed in any one day; 1 specimen tested at 7 days, and 2 specimens tested at 28 days, 1 held. Cast, store and cure specimens as specified in ASTM C31.
 - 1) Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
 - 2) Concrete that does not meet the strength requirements is subject to rejection and removal from the Work, or to other such corrective measures as directed by ENGINEER, at the expense of CONTRACTOR.
 - e. Concrete Temperature: Test each time a slump test is made.
 - 2. Where questionable field conditions may exist during placing concrete or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded at the same time and from the same samples as the laboratory cured specimens.
 - a. Provide improved means and procedures for protecting concrete when the 28day compressive strength of field- cured cylinders is less than 85% of companion laboratory-cured cylinders.
 - b. When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi even though the 85 percent criterion is not met.
 - 3. The testing laboratory shall submit certified copies of test results directly to ENGINEER and CONTRACTOR after tests are made.
- C. Evaluation of Quality Control Tests:
 - 1. Do not use concrete delivered to the final point of placement that has slump or temperature outside the specified values, nor that which is older than specified in paragraph 3.2, Transporting Concrete.
 - 2. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength tests results equal or exceed the 28 day design compressive strength of the type

or class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi.

- 3. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to replacement, reconstruction or to other action approved by ENGINEER.
- D. Testing Concrete Structure for Strength:
 - 1. When there is evidence that the strength of the in-place concrete does not meet specification requirements, provide the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination at no additional expense to OWNER. Provide tests complying with ASTM C42 and the following:
 - a. Take at least three (3) representative cores from each member or suspect area at locations directed by ENGINEER.
 - b. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85% and no single core is less than 75% of the 28 day required compressive strength.
 - c. Report test results, in writing, to ENGINEER on the same day that tests are made. Include in test reports the Project identification name and number, date, name of CONTRACTOR, name of concrete testing service, location of test core in the structure, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.
 - 2. Fill core holes solid with non-shrink, high strength grout, and finish to match adjacent concrete surfaces.
- E. Water Leakage Tests for All Water-Holding Structures:
 - 1. All water-holding structures shall be subjected to leakage tests after the concrete has been cured and obtained its design strength, and before backfill, brick facing, or other work which will cover the concrete surfaces of the walls is begun. Water leakage tests shall be conducted by the CONTRACTOR as follows:
 - a. All water-holding structures shall be filled with water to the maximum liquid level shown on the Drawings prior to leak testing at a rate less than 4 fph. After these structures have been kept full for 3-days, it will be assumed for the purpose of the test that the absorption of moisture by the concrete in the basin is complete. All valves and gates to the structure shall then be closed and the change in water surface measured over a 48-hour period. The vertical distance to the water surface shall be measured to within 1/16-inch from a fixed point on the containment structure above the water surface. Measurements shall be recorded at 24-hour intervals.
 - b. During the test period, all exposed portions of the structure shall be examined for dampness or leaks and all visible leaks or damp spots shall be marked; such leaks or damp spots shall be later patched or corrected in a manner acceptable to the ENGINEER prior to additional leakage testing. If the drop in water surface in the 48-hour period exceeds 0.05% of the normal volume of liquid contained in the water-holding structure, after accounting for evaporation, precipitation and temperature in open basins, or if damp spots or any seepage is present on the walls or other areas exposed to view where moisture can be picked up on a dry hand, the leakage shall be considered excessive and the leakage test will be considered to have failed. A floating, restrained, partially filled, calibrated, open

container for evaporation and precipitation measurement should be positioned in open containment structures, and the water level in the container recorded. Determination of evaporation by a shallow pan-type measuring device is discouraged as the heating of the bottom of a shallow pan can cause accelerated evaporation of water when compared with that taking place from a deep containment structure.

- 1) Wet areas on top of wall footings shall not be considered cause of a qualitative failure of the leakage test unless the water can be observed to be flowing.
- c. If the leakage is excessive, and if damp spots and observed seepage is present on exposed surfaces, the water-holding structure shall be drained, all leaks and damp spots previously marked shall be patched, and the necessary repairs made, and the basin shall be retested. The CONTRACTOR's method of repair shall be subject to the requirements of these specifications and submitted for review and approval by the ENGINEER.
- d. The water-holding structure shall then be refilled and again tested for leakage and this testing and repair process shall be repeated as many times as necessary until the leakage test passes. This process shall be continued until the drop in water surface in specified test period with the basin full is less than the quantity specified above and all damp spots and seepage disappears when the structures are full of water. All repairs of faulty workmanship and materials, and additional tests, shall be made by the CONTRACTOR in an acceptable manner, at no additional cost to the OWNER. Both the correction for excessive leakage and the removal of the damp or wet spots on exposed surfaces shall be required to pass the leakage test.
- e. The purpose of this test is to determine the integrity of the finished concrete and to show that the exposed wall surfaces are visually acceptable. Therefore, all other equipment, e.g., stop gates, sluice gates, etc. or temporary bulkheads, should be made watertight prior to the test.
- f. As an alternative to having watertight bulkheads, gates or valves, the CONTRACTOR shall accurately measure the leakage through gates, valves, and bulkheads with methods acceptable to the ENGINEER.
- g. An assumed leakage through gates and valves based on the manufacturer's recommendations is not acceptable.

3.8 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for the passage of work by other contractors, unless otherwise shown or directed, after the work of other contractors is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.
- B. Curbs:
 - 1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
 - 2. Exterior curbs shall have rubbed finish for vertical surfaces and a broom finish for top surfaces.
- C. Equipment Bases:

- 1. Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Construct bases to the dimensions shown, or as required to meet manufacturer requirements and drawing elevations. Where no specific elevations are shown, bases shall be 6-inches thick and extend 3-inches outside the metal equipment base or supports. Bases to have smooth trowel finish, unless a special finish such as terrazzo, ceramic tile or heavy-duty concrete topping is required. In those cases, provide appropriate concrete finish.
- 2. Include all concrete equipment base work not specifically included under other sections.
- 3. In general, place bases up to 1 inch below the metal base. Properly shim equipment to grade and fill 1inch void with non-shrink grout as specified in Section 03 60 00, Grout.
- D. Installation of embedded items
 - 1. Install all embedded items prior to concrete placement, or, if necessary, as soon after concrete placement as possible, before concrete is set.
 - 2. Use temporary support and bracing to keep embedded items in place while concrete cures.
 - 3. Protect all embedded items from damage during concrete installation.

3.9 CONCRETE REPAIRS

- A. Repair of Formed surfaces:
 - 1. Repair exposed-to-view formed concrete surfaces that contain defects which adversely affect the appearance of the finish. Surface defects that require repair include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.
 - 2. Repair concealed formed concrete surfaces that may contain defects that adversely affect the durability of the concrete. Surface defects that require repair include cracks in excess of 0.01-inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corner.
 - 3. Repair structural cracks and cracks in water-holding structures.
- B. Method of Repair of Formed Surfaces:
 - 1. Repair and patch defective areas with cement mortar immediately after removal of forms and as directed by ENGINEER.
 - Cut out honeycomb, rock pockets, voids over 1/2-inch diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with the specified bonding agent.
 - a. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, the patching mortar color will match the color of the surrounding concrete. CONTRACTOR shall impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

- 3. Cracks which require repair shall be pressure grouted, epoxy injected, using one of the following in accordance with Section 03 64 23, Crack Repair by Epoxy Injection. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation Company.
 - b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
 - c. Or approved equal.
- 4. Fill holes extending through concrete by means of a plunger- type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling.
- 5. Sandblast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.
- C. Repair of Unformed Surfaces:
 - 1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
 - 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
 - 3. Repair finish of unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 - 4. Repair structural cracks and cracks in water-holding structures.
- D. Methods of Repair of Unformed Surfaces:
 - 1. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
 - Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Use one of the following. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Euco Poly-Patch, as manufactured by The Euclid Chemical Company.
 - b. Sikatop 122, as manufactured by Sika Corporation.
 - c. Or approved equal.
 - 3. Repair defective areas, except random cracks and single holes not exceeding 2 inches in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
 - 4. Repair isolated random cracks, as approved be ENGINEER, and single holes not over 2 inches in diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen

all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of 1 part portland cement to 2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

- 5. Cracks which extend through the full member section, or any cracks determined by ENGINEER to require pressure grouting repair, shall be pressure grouted, epoxy injected, using one of the following in accordance with Section 03 64 23, Crack Repair By Epoxy Injection. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation.
 - b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
 - c. Or approved equal.
- 6. Assure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.
- E. Other Methods of Repair:
 - 1. Repair methods not specified above may be used if approved by ENGINEER.

+ + END OF SECTION + +

SECTION 03 40 00

PRECAST CONCRETE

<u> PART 1 - GENERAL</u>

1.1 DESCRIPTION

A. Section includes all plant-precast products, including, but not limited to, wet wells, catch basins, manholes, vaults, and wheel stops.

1.2 SYSTEM DESCRIPTION

- A. Precast products shall be designed for the indicated service, the loadings specified in the Contract Documents, and all transportation, handling, and erection loads, in accordance with requirements and recommendations of the references.
 - 1. Precast products not subjected to traffic loads shall be designed to meet and exceed the requirements of ACI 318-14.
 - 2. Precast products subjected to traffic loads shall be designed to meet and exceed the requirements of the current AASHTO LRFD Bridge Design Specifications.
 - 3. Precast products containing wastewater shall be designed for the additional requirements of ACI 350-06.
- B. If precast products are proposed as substitutes for cast-in-place designed structures, such precast products shall meet the above requirements and any other requirements for which the cast-in-place structures were designed by the ENGINEER. Such products shall be designed by an engineer licensed to practice in the State where the project is performed.
- C. Items located in or adjacent to traffic areas shall be designed to resist AASHTO HL93 loading, unless otherwise indicated.
- D. Lifting inserts shall have a minimum safety factor of 4.

1.3 REFERENCES

- A. American Concrete Institute, ACI
- B. PCI Manual for Quality Control for Plants and Production of Structural Precast Concrete Products, MNL-116
- C. American Society for Testing and Materials, ASTM
- D. American Welding Society, AWS
- E. AASHTO LRFD Bridge Design Specifications
- F. American Public Works Association Standard Specifications as Adopted and Modified by Provo City

1.4 QUALIFICATIONS

- A. Manufacturer:
 - 1. Manufacturer shall have at least 5 years of experience in the design and manufacture of precast concrete products substantially similar to those required for this project.
 - 2. For identified critical precast items, the precast manufacturing plant shall be certified by the National Precast Association (NPCA). National Precast Association (NPCA).
- B. Installer:
 - 1. Precast Items shall be installed by the Manufacturer or by an installer regularly engaged for at least 5 years in erection o precast products similar to those required on this project.

1.5 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Shop Drawings:
 - 1. Submit to the ENGINEER for review, shop drawings of the proposed details, and design calculations; all calculations and shop drawings shall be stamped and signed by a Civil or Structural ENGINEER registered in the State of Utah.
 - 2. Material specifications.
 - 3. All dead, live and other applicable loads used in the design.
 - 4. Applicable standards (from "References") met by the item(s).
 - 5. Setting plans locating and designating all items furnished by the manufacturer, with all major openings shown and located
 - 6. Details to indicate quantities, location and type of reinforcing and prestressing steel.
 - 7. Sections and details showing connections, edge conditions, support conditions, and connections of the items.
 - 8. Description of all embeds, including stripping, lifting and erection inserts, with piece mark and location, including those cast into products or sent loose to the job site.
 - 9. Description and drawings of all frames and covers.
 - 10. Dimensions and special finishes.
- C. Mix Designs: Submit all precast mix designs for approval. Mix designs shall be prepared by an independent testing facility or qualified employee of the Precast Manufacturer.
- D. Design Modifications:
 - 1. Submit design modifications necessary to meet performance requirements and field conditions.
 - 2. Variations in details or materials shall not adversely affect the appearance, durability or strength of products.
 - 3. Maintain general design concept without altering size of members, profiles and alignment unless otherwise approved by the Architect/ENGINEER.

1.6 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of Section 01 45 00, Quality Control
- B. In-Plant Quality Control

- 1. The Manufacturer shall have an established PCI quality control program in effect prior to bidding. If requested, a copy of this program shall be submitted to the ENGINEER.
- 2. Testing of materials and inspection of production techniques shall be the responsibility of the Manufacturer's Quality Control Department.
- 3. Keep quality control records available for two years after final acceptance.
- 4. Keep certificates of compliance available for five (5) years after final acceptance.
- C. All other testing and inspection, if any, to be provided by OWNER.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handle and transport products in a position consistent with their shape and design in order to avoid excessive stresses or damage.
- B. Lift or support products only at the points shown on the shop drawings.
- C. Installer shall be responsible for the repair of damage to items except that caused by others.
- D. After items are installed in their final positions, the CONTRACTOR shall be responsible for their protection. The CONTRACTOR shall be responsible for the repair of any damage to the items caused by someone other than the Manufacturer/Installer.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement ASTM C150 Type I, II or III cement.
- B. Aggregates:
 - 1. Fine and coarse aggregate for mix shall conform to ASTM C33 or C330.
 - 2. Aggregates shall be clean, hard, strong, durable, inert, and free of staining and deleterious materials.
- C. Water Potable, free from deleterious material.
- D. Admixtures:
 - 1. Conforming to ASTM C260 and/or ASTM C494.
 - 2. Calcium chloride or admixtures containing chlorides shall not be used.
- E. Concrete Strength: Concrete strength shall be determined by design with a minimum 28-day design strength of 4,000 psi.

2.2 STEEL MATERIALS

- A. Products:
 - 1. Structural Shapes, Bars & Plates (1.6mm and thicker): ASTM A36
 - 2. Pipe: ASTM A53 Grades A or B
 - 3. Tube Steel: ASTM A500 Grades A or B
 - 4. Reinforcing Steel: ASTM A615 Grades 300 & 420 or ASTM A706
 - 5. Prestressing Strand: ASTM A416 Grade 270, low relaxation

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- 6. Deformed Steel Bar Mats: ASTM A184
- 7. Deformed Bar Anchors: ASTM A496
- 8. Deformed Welded Wire Fabric: ASTMA497
- 9. Plain Welded Wire Fabric: ASTM A185
- 10. Welded Headed Studs: AWS D1.1 Type B
- 11. Standard Machine Bolts: ASTM A307 Grade A or SAE J429 Grade 2
- 12. Standard Studs/Threaded Round Stock: ASTM A307 Grade C, ASTM A572 Grade 345
- 13. Nuts for Standard Machine Bolts and Threaded Studs: ASTM A563 Grade A Hex Nuts
- 14. High Strength Bolts: ASTM A325 Type 1, ASTM A449 Type 1, or SAE J429 Grade 5
- 15. Nuts for High-Strength Bolts and Threaded Studs: ASTM A563 Grade DH Heavy Hex Nuts
- 16. Coil Rods and Bolts: ASTM A108 SAE 1016 to 1026, F_{u}/F_{Y} = 480/380 MPa minimum
- 17. Coil Nuts for Coil Rods and Bolts: Nuts passing a proof load stress of 80 ksi, based on the tensile stress area of the matching coil rods and bolts.
- 18. Carbon Steel Castings: ASTM A27 Grade 415-205
- B. Protective Coatings:

All connection hardware permanently exposed to weather after completion shall be protected. All connection hardware not exposed to weather after completion may be uncoated, except as otherwise explicitly required by the contract drawings. Fasteners can have either an electroplated zinc or cadmium coating.

- 1. Alkyd Rust Inhibitive Primers (shop primers such as red iron oxide):
 - a. Tnemec Series FD88 Azeron Primer
 - b. Ameron 5105
 - c. Weld-Thru Primer, Red, 2-0101 & Gray, 2-0102
- 2. Zinc Coatings:
 - a. Hot-Dip Galvanizing: ASTM A123, or ASTM A153
 - b. Electroplated Zinc for Steel Products and Steel Hardware: ASTM B633
 - c. Zinc Rich Paints: DOD-P-21035
- 3. Cadmium Coatings:
 - a. Electrodeposited Coatings of Cadmium: ASTM B766

2.3 MISCELLANEOUS PRODUCTS

- A. Grout:
 - 1. Cement Grout: Portland cement, sand and water sufficient for placement and hydration.
 - 2. Non-Shrink Grout: Premixed, packaged non-ferrous aggregate shrink resistant.
 - 3. Epoxy Resin Grout: Two-component mineral-filled resin: ASTM C881.
- B. Joint Sealing Compound: The joint sealing compound shall be a permanently flexible plastic material complying in every detail to Federal Specification SS S-00210 (GSA-FSS) dated July 26, 1965.
 - 1. Ram-Nek
 - 2. Con-Seal
 - 3. or approved equal.
- C. Frames and Covers: Catch basins, manholes, and vaults shall be provided with fabricated aluminum or steel frames and covers as specified or shown on the drawings and shall be built up so that the cover is flush with the surrounding surface unless otherwise specified.

2.4 FABRICATION

- A. Unless otherwise noted, precast concrete structure dimensions called out on the Drawings are interior dimensions.
- B. Manufacturing procedures shall be in general compliance with PCI MNL-116.
- C. Manufacturer shall provide for those openings 10 inches or larger, round or square as shown on the drawings. Other openings shall be located and field drilled or cut by the trade requiring them after the units have been erected. Openings and/or cutting of prestressing strand shall be approved by ENGINEER and manufacturer before drilling or cutting.
- D. Forms:
 - 1. Forms for precast products shall be rigid and constructed of materials that will result in finished products conforming to the profiles, dimensions and tolerances indicated by this section, the Contract Documents and the reviewed shop drawings.
 - 2. Construct forms to withstand vibration method selected.
 - 3. Release agents shall be applied and used according to manufacturer's instructions.
- E. Concreting:
 - 1. Batching of Concrete shall be in accordance with approved Mix Design(s).
 - 2. Convey concrete by methods which will prevent separation, segregation or loss of material.
 - 3. Consolidate all concrete in the form to minimize honeycombing or entrapped air.
- F. Curing: Procedures sufficient to insure specified concrete strength of all products must be employed. Stripping of a panel shall not occur until concrete strength is sufficient to prevent cracking or damage of the panel.
- G. Manufacturing Tolerances:
 - 1. Cross Sectional Dimensions:
 - a. Less than 24 inches: $\pm 1/4$ inch
 - b. 24 to 36 inches: ±3/8 inch
 - c. Over 36 inches: $\pm 1/2$ inch
 - 2. Length:
 - a. Less than 25 feet: $\pm 1/2$ inch
 - b. 25 to 50 feet: ±3/4 inch
 - c. Over 50 feet: ±1 inch
 - 3. Variation from square or designed skew (difference in length of two diagonal measurements): Max. $\pm 3/4$ inch
- H. Identification: Mark each precast item to correspond to identification mark on shop drawings for product location, and with casting date. Recognized manufacturers of these products include Geneva Pipe, Oldcastle Infrastructure, and Harper Precast Concrete. Product must meet all applicable specification requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Access: Clear unloading areas and access roadways to point of component placement shall be provided and maintained by the CONTRACTOR. The CONTRACTOR shall provide all required traffic controls, barricades, warning lights and/or signs to insure a safe installation.
- B. Sitework: The CONTRACTOR shall excavate and prepare the subgrade, including 12 inches of 3/4-inch drain rock, graded level and to the proper elevation.
- C. Installer Responsibility: Prior to installation of the precast products, notify the CONTRACTOR of any discrepancies discovered which affect the work under this contract.

3.2 INSTALLATION

- A. General: Precast products shall be lifted with suitable lifting devices at points provided by the Manufacturer to prevent excessive stresses or damage to the products. Brace and secure items before unhooking.
- B. Sitework:
 - 1. Openings or "knockouts" shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or coupling flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 4,000-psi concrete or mortar, using an approved epoxy for bonding concrete surfaces.
 - 2. All joints between precast sections shall be made watertight using preformed mastic material. The sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure. All joints shall be filled with dry-pack non-shrink grout. If plastic liner system is used, after the joint has been made <u>and is cured</u>, install plastic liner weld strip at all joints and seams.
 - 3. Frames and covers shall be built up so that the cover is flush with the surrounding surface unless otherwise specified. The CONTRACTOR is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.
 - 4. After the structure and all appurtenances are in place and approved, and after any required disinfection or testing, backfill shall be placed to the original ground line or to the limits designated on the plans.

3.3 FIELD QUALITY CONTROL

- A. Hydrostatic Testing:
 - 1. All Manholes, Wetwells, Junction Boxes, or other water bearing structures shall be hydrostatically tested prior to acceptance.

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- 2. Test Procedure:
 - a. Plug all inlets and outlets with temporary plugs
 - b. Fill water bearing structure with clean, potable water
 - c. Let stand for 24 hours, if desired, to allow for "soaking-in"
 - d. Fill to top of highest manhole section
 - e. Let stand for a minimum of 2 hours

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- f. Check distance from rim to water surface
- g. Calculate water loss. Leakage in each manhole may not exceed 0.1-gph per foot of water depth during the test.
- 3. Repair all structures which do not meet the above test requirements with a method approved by the ENGINEER and re-test until passing.

3.4 PATCHES AND REPAIRS:

A. Patching of products, when required, shall be performed to industry standards for structural concrete. Repairs shall be sound, permanent and flush with adjacent surface.

3.5 WARRANTY:

- A. Warranties shall be in accordance with the requirements of Section 01 78 36, Product Warranty
- B. All labor and materials under the Precast Manufacturers contract shall be warranted by the Precast Manufacturer for a period of one (1) year after substantial completion.

+ + END OF SECTION + +

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SECTION 03 60 00

GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes epoxy, non-metallic, non-shrink, and ordinary Portland cement-sand grouts.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33, Standard Specification for Concrete Aggregates.
 - 2. ASTM C150, Standard Specification for Portland Cement.
 - 3. ASTM C595, Standard Specification for Blended Hydraulic Cements.
 - 4. ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout.
 - 5. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 6. ACI 301, Specifications for Structural Concrete for Buildings

1.3 SYSTEM DESCRIPTION

- A. Furnish ordinary cement-sand grout for the following:
 - 1. Foundation grout.
 - 2. Construction joint grout.
 - 3. As shown in the Drawings.
- B. Furnish non-shrink, non-metallic grout for the following:
 - 1. Equipment bases, 25 hp or less.
 - 2. Base plates.
 - 3. Guardrail and railings.
 - 4. Through-bolt and form tie openings.
 - 5. As shown in the Drawings.

C. Furnish epoxy grout for the following:

- 1. Equipment bases, 26 hp or more and/or sole plates with vibration, thermal movement, etc.
- 2. Blockouts for gate guides.
- 3. Retrofit waterstop installation.
- 4. As shown in the Drawings.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and installation instructions for all proprietary materials.
 - 2. Proposed method for keeping existing concrete surfaces wet prior to placing grout.
 - 3. Forming method for fluid grout placements.
 - 4. Curing method for grout.

- B. Laboratory Test Reports and Certificates:
 - 1. For proprietary materials, submit copies of reports on quality control tests.
 - 2. Submit certification that materials meet specification requirements for nonproprietary materials.
 - 3. For ordinary cement-sand grout, copies of grout mix design and laboratory strength test reports.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Deliver grout materials from manufacturers in unopened containers and bearing intact manufacturer's labels.
- B. Storage of Materials: Store grout materials in a dry shelter and protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. High-Strength Epoxy Grout.
 - 1. Use 100% solids, prepackaged, solvent-free, moisture insensitive, high-strength epoxy grout.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. E³-HP, as manufactured by The Euclid Chemical Company.
 - b. Sikadur 42 Grout Pak, as manufactured by Sika Corporation.
 - c. Five Star HP Epoxy Grout by Five Star Products, Incorporated.
 - d. Or approved equal.
- B. Non-shrink, Non-metallic Grout:
 - 1. Prepackaged non-staining cementitious grout which shall meet the minimum requirements of ASTM C1107 and requiring only the addition of water at the jobsite.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. NS, as manufactured by The Euclid Chemical Company.
 - b. Five Star Grout, as manufactured by Five Star Products, Incorporated.
 - c. Sika Grout 212, as manufactured by Sika Corporation.
 - d. Or approved equal.
- C. Ordinary Cement-Sand Grout: Prepare design mix for ordinary cement grout.
 - 1. Cement: Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type 1P.
 - 2. Aggregates: ASTM C33 and as herein specified.
 - a. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
 - b. Fine Aggregate: Clean, sharp, natural sand, free from loam, clay, lumps or other deleterious substances.
 - 1) Dune sand, bank run sand and manufactured sand are not acceptable.
 - c. Coarse Aggregate: Coarse aggregate is not permitted.
 - 3. Admixtures: Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed instruction. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless

otherwise authorized in writing by ENGINEER. Refer to Section 03 30 00, Cast-In-Place Concrete, for additional admixture requirements.

- 4. Proportioning and Design of Mixes:
 - a. Mixes are subject to the following limitations:
 - 1) Specified 28-day Compressive Strength: 4,000 psi
 - 2) Minimum amount of water necessary for the mixture to flow under its own weight
 - 3) Fine Aggregate meeting ASTM C33
 - 4) Air Content Percentage: ±1.5%
 - 5) Minimum Cement Content in Pounds per Cubic Yard: 658
 - 6) Slump at point of placement: 5"±1"
 - b. Proportion mix by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and provide a complete report, from an independent testing laboratory, to ENGINEER, at least 30 days prior to start of Work. Do not begin grout production until ENGINEER has approved mix.
- 5. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Chapter 3 Proportioning.
- 6. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Chapter 4.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and conditions under which grout is to be placed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER at no cost to the OWNER.

3.2 INSTALLATION

- A. General:
 - 1. Mix, place and cure grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until ENGINEER provides clarification.
 - 2. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions. The cost of this service, if any, shall be borne by CONTRACTOR.
 - 3. When placing grout conform to temperature and weather limitations in Section 03 30 00, Cast-In-Place Concrete.
- B. Through-bolt and form-tie holes: Fill space with dry pack dense grout hammered in with steel tool and hammer. Coordinate dry pack dense grout application with bonding agent in Section 03 15 16, Concrete Joints.
- C. Columns, Beams and Equipment Bases: Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material prior to setting base plates and machinery. After shimming columns, beams and equipment indicated to be

grouted on the plans to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with grout.

- D. Guardrails and Railings: After posts and rails have been properly inserted into holes or sleeves, fill the annular space between posts and cast-in-place sleeves and/or below base plates with non-shrink grout. Bevel grout at juncture with post so that moisture flows away from posts.
- E. Construction Joints: Ordinary cement-sand grout may be used in place of mortar over the contact surface of the old concrete at the interface of horizontal construction joints as outlined in Section 03 15 16, Concrete Joints, and Section 03 30 00, Cast-In-Place Concrete, of these Specifications.
- F. Curing: Cure all grout in accordance with manufacturer's written instructions. Wet cure ordinary cement-sand grout and non-shrink non-metallic grout for a minimum of three (3) days unless directed otherwise by the ENGINEER.

+ + END OF SECTION + +

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SECTION 03 64 23

CRACK REPAIR BY EPOXY INJECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall furnish all material, tools, equipment, appliances, transportation, labor and supervision required to repair cracks by the injection of an epoxy resin adhesive.

1.2 QUALITY ASSURANCE

- A. Qualifications for Epoxy Injection Staff:
 - 1. Manufacturer's Site Representative:
 - a. Capable of instructing successful methods for restoring concrete structures utilizing epoxy injection process.
 - b. Understands and is capable of explaining technical aspects of correct material selection and use.
 - c. Experienced in the operation, maintenance, and troubleshooting of application equipment.
 - 2. Injection crew and job foreman shall provide written and verifiable evidence showing compliance with the following requirements:
 - a. Licensed and certified by epoxy manufacturer.
 - b. Minimum 3 years' experience in successful epoxy injection for at least 10,000 linear feet of successful crack injection including 2,000 linear feet of wet crack injection to stop water leakage.
 - 3. CONTRACTOR shall retain the services of a qualified and authorized technical representative of the materials manufacturer to provide a site visit to specifically address the parameters of the repair and provide recommendations at the beginning of the installation and to make periodic visits to ensure that the work is performed in accordance with the manufacturer's recommendations and achieves the repair objectives.

1.3 REFERENCE STANDARDS

- A. ASTM D638, Plastics Tensile Strength
- B. ASTM D695, Standard Test Method for Compressive Properties of Rigid Plastics
- C. ASTM D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- D. ASTM D570, Standard Test Method for Water Absorption of Plastics
- E. ASTM C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
- F. ASTM C496, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

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1.4 SUBMITTALS

- A. Product Data: Submit copies of manufacturer's specifications and installation instructions for all materials and accessories including:
 - 1. Manufacturer's recommended surface preparation procedures and application instruction for epoxy adhesives.
 - 2. Installation instructions for repairing core holes with epoxy grout.
 - 3. Manufacturer's Certificate of Compliance: Certified test results for each batch of epoxy adhesive.
 - 4. Statements of Qualification for Epoxy Adhesive:
 - a. Manufacturer's site representative
 - b. Injection applicator
 - c. Injection pump operating technician
 - 5. Epoxy adhesive two component ratio and injection pressure test records for concrete crack repair work

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Package adhesive material in new sealed containers and label with the following information:
 - 1. Manufacturer's name
 - 2. Product name and lot number
 - 3. Material Safety and Data Sheet (MSDS)
 - 4. Mix ratio by volume
- B. Store adhesive containers at ambient temperatures below 100 degrees F and above 45 degrees F. Condition adhesive before use as recommended by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Materials, equipment and accessories specified in this section shall be products of one of the following:
 - 1. Concresive Series, as manufactured by BASF Building Systems
 - 2. Sikadur Series, as manufactured by Sika Corporation
 - 3. Euco Series, as manufactured by Euclid Chemical Company

2.2 EPOXY ADHESIVE

- A. Epoxy adhesive grout shall be a 100% solids 2-part water insensitive low-viscosity epoxy resin system.
- B. Epoxy shall be suitable for grouting both dry and damp cracks.

C. Adhesive Properties:

7-day, Tensile Strength, psi	ASTM D638	5,000 min.
Tensile Elongation @ Break, percent	ASTM D638	1.0% min.
Compressive Yield Strength, 7 days @ 73°F, psi	ASTM D695	8,000 min.
Compressive Modulus, psi	ASTM D695	1.5x10 ⁵ min.
Heat Deflection Temperature, °F	ASTM D648	120 min.
Water Absorption @ 24 hours, percent	ASTM D570	1.0% max.
Bond Strength @ 2 days, psi	ASTM C882	1,000 min.
Bond Strength @ 14 days, psi	ASTM C882	1,500 min.

2.3 SURFACE SEAL

- A. The surface seal material is that material used to confine the injection adhesive in the fissure during injection and cure.
- B. The surface seal material shall have adequate strength to hold injection fittings firmly in place and to resist injection pressures adequately to prevent leakage during injection.
- C. Capable of removal after injection adhesive has cured.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean cracks in accordance with epoxy adhesive manufacturer's instructions.
- B. Surface adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil, efflorescence or other foreign matter which may be detrimental to the integrity of the bond between the epoxy and the injection surface. Acids and corrosives used for cleaning shall not be permitted.
- C. Entry ports shall be provided along the crack at intervals of not less than the thickness of the concrete at that location, unless otherwise specified by the adhesive manufacturer.
- D. Unless the crack is in submerged concrete, remove any water that can be seen by visual inspection from the crack before the injection process, and remove water that appears during the injection process.
- E. Do not inject cracks when the temperature of the concrete is below freezing and moisture conditions indicate the possibility of ice on the internal surfaces of the crack.
- F. Do not inject adhesive if the temperature of the concrete is not within the range of application temperatures recommended by the manufacturer of the adhesive.

3.2 INSTALLATION

A. Sealing: Apply surface seal in accordance with manufacturer's instructions to designated crack face prior to injection. Seal surface of crack to prevent escape of injection epoxy.

- B. Entry Ports:
 - 1. Establish openings for epoxy entry in surface seal along crack.
 - 2. Determine space between entry ports equal to thickness of concrete member to allow epoxy to penetrate the full thickness of the wall.
 - 3. Provide a means to prevent concrete dusts and fines from contaminating the crack or ports when drilling.
 - 4. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
 - a. Cracks extend entirely through wall.
 - b. Backfill of walls on one side.
 - c. Difficult to excavate behind wall to seal both crack surfaces.
 - d. Core drill to verify epoxy depth where only one side of wall is exposed.
- C. Epoxy Injection:
 - 1. Condition epoxy at a minimum of 70°F, or as recommended by the manufacturer.
 - 2. Start injection into each crack at lowest elevation entry port.
 - 3. Continue injection at first port until adhesive begins to flow out of port at next highest elevation.
 - 4. Plug first port and start injection at second port until adhesive flows from next port.
 - 5. Inject entire crack with same sequence.
- D. Finishing:
 - 1. Cure epoxy adhesive after cracks have been completely filled to allow surface seal removal without draining or runback of epoxy material from cracks.
 - 2. Remove surface seal from cured injection adhesive.
 - 3. Finish crack face flush with adjacent concrete.
 - 4. Indentations or protrusions caused by placement of entry ports are not acceptable.
 - 5. Remove surface seal material and injection adhesive runs and spills from concrete surfaces.
- E. Equipment:
 - 1. The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.
 - 2. The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi plus or minus 5 psi and shall be equipped with a manual pressure control override.
 - 3. The injection equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of plus or minus 5 percent by volume at any discharge pressure up to 160 psi.
 - 4. Do not use batch mix pumps.

3.3 FIELD QUALITY CONTROL

- A. Injection Pressure Test:
 - 1. The mixing head of the injection equipment shall be connected and the equipment run until clear uniformly mixed material flows into the purge pail. The Operator

shall engage the equipment shut-off nozzle valve and subsequently bump the on-off switch while monitoring pressure on psi gauge until the pressure reaches 200 psi. Pressure gauge shall be monitored for one minute. If pressure is maintained between 190 – 200 psi, check valves shall be considered to be functioning properly and the injection may proceed. If pressure drops below 190 psi, CONTRACTOR shall be required to have new seals installed on the check valves and the equipment shall be subsequently retested.

- 2. The pressure test shall be run for each injection unit at the beginning and after meal break of every shift that the unit is used in the work of crack repair.
- 3. The adequacy and accuracy of the equipment shall be solely the responsibility of CONTRACTOR.
- B. Metering Accuracy Ratio Test:
 - 1. The epoxy mixture ratio shall be monitored continuously while injecting by placing a strip of masking tape on the sides of the A & B reservoirs full height. After filling reservoirs, the A & B levels shall be marked and monitored while running injection machine into purge pail for a period of one minute at 160 psi discharge pressure.
 - 2. The ratio test shall be run for each injection unit at the beginning of every shift that the unit is used in the work of crack repair and when injection work has stopped for more than 1 hour.
- C. Proof of Ratio and Pressure Test:
 - 1. At all times during the course of the work CONTRACTOR shall keep complete and accurate records available to ENGINEER of the pressure and ratio tests specified above.
 - 2. In addition, ENGINEER at any time without prior notification of CONTRACTOR, may request CONTRACTOR to conduct the tests specified above in the presence of ENGINEER.
- D. Daily Log
 - 1. Maintain a written daily log for each day of injection work that includes:
 - a. Ambient temperatures at the start and end of the workday and 4 hours after the end of the workday.
 - b. Weather conditions, such as rain, snow, and wind, including changes during the shift.
 - c. Crack cleaning methods, if any, including locations.
 - d. Record of injection adhesive, including manufacturer, product and batch number, and amount used each day.
 - e. Signature and printed name of person responsible for record keeping.
- E. Core Testing
 - 1. Initial Cores:
 - a. Obtain 4-inch diameter cores for the full crack depth taken from ENGINEER selected locations.
 - b. Visual inspection for depth of penetration:
 - 1) Three cores from the first 100 feet and one core for each 100 feet thereafter.
 - 2) It is permitted to obtain 2-inch cores if they are only used to verify adhesive penetration.
 - c. Splitting tensile strength per ASTM C496:
 - 1) One core for the first 100 feet and once core for each 75 feet thereafter.

- d. Mark each of the cores with a "T" for top or "B" for bottom for cores taken vertically, or "H" for cores taken horizontally.
- e. Mark the respective end of the core with the letters "IS" (injection side) to indicate the side from which the injection was performed.
- 2. Test Requirements:
 - a. Adhesive Penetration: Minimum of 90% of the crack shall be full of epoxy adhesive.
 - b. Splitting tensile strength / Compression Test: Concrete failure before adhesive failure, or 6,500 psi with no failure of either concrete or adhesive.
- 3. Acceptance Criteria:
 - a. If initial cores pass the tests as specified, epoxy adhesive injection Work at the area represented by cores will be accepted.
 - b. If adhesive penetration or bond strength are not acceptable, stop injection Work until the areas represented by the testing are accepted, and changes in procedures or materials for continued injection Work have been accepted. Reinject adhesive in the locations where injection has not been acceptable. If partial injection has blocked all access to the cracks on surfaces that can be reinjected, drill injection holes into the concrete to intersect the crack in their void areas.
- F. Core Hole Repair:
 - 1. Fill core holes with epoxy grout as required by the Project Specifications. Finish surface shall blend with adjacent concrete.

+ + END OF SECTION + +

SECTION 05 00 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 SUMMARY

A. Work necessary to furnish and install, complete, fabricated metalwork and castings as shown or as required to secure various parts together and provide a complete installation.

1.2 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of 01 33 00, Submittal Procedures.
- B. Shop Drawings: Submit shop drawings for the fabrication and erection of the miscellaneous metal Work. Include plans, elevations and details of sections and connections. Clearly show all field connections. Show anchorage and accessory items.
- C. Product Data: Submit copies of manufacturer's specifications, load tables, dimensions, diagrams, anchor details, and installation instructions for manufactured products.
- D. Samples: Submit representative samples of manufactured products.

1.3 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of 01 45 00, Quality Control.
- B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting of the Work.
- C. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units to the extent necessary for shipping limitations. Clearly mark units for reassembly and coordinated installation.
- D. Qualifications: Qualify welding operators in accordance with requirements of current AWS Standard Performance Qualification Procedures in the applicable structural welding code.
 1. Qualification Tests: Performed by a recognized testing laboratory.
 - 1. Qualification Tests: Performed by a recognized testing laboratory.

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E. Certification: Certify welders of structural and reinforcing steel for all positions of welding in accordance with such procedure.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Like Items of Materials: Provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer's service.
- B. Lifting Lugs: Provide on equipment and equipment components weighing over 100 lb.
- C. Furnish miscellaneous items:
 - 1. Miscellaneous metalwork and castings as shown, or as required to secure various parts together and provide a complete installation.
 - 2. Items specified herein are not intended to be all-inclusive. Provide metalwork and castings shown, specified, or which can reasonably be inferred as necessary to complete the project.

2.2 MATERIALS

- A. Carbon steel structural shapes: Refer to Section 05 10 00, Structural Steel.
- B. Stainless Steel:
 - 1. Plates and Sheets: ASTM A240, Type 304L or 316
 - 2. Structural shapes: ASTM A276, A479 or A1069, Type 304L or 316.
 - 3. Fasteners and fittings: ASTM A320, Type 316
 - a. Where stainless steel bolts are in contact with dissimilar metals provide insulating sleeves and phenolic washers to electrically isolate the bolts and nuts.
- C. Aluminum, Structural Shapes and Plates: Alloy 6061-T6, meeting Aluminum Assoc. Specification for Aluminum Structures
- D. Cast Iron: A48, Class 30
- E. Light Gauge Steel Framing:
 - 1. Manufactured by SSMA ICC ESR-3064P, or equivalent, to meet the requirements of AISI S100.
 - 2. ASTM A570 or A446 with a minimum yield strength of 33 ksi for 18 gauge and 20 gauge, 50 ksi for 14 gauge and 16 gauge.
 - 3. Framing members shall have the section properties as listed on the Drawings.
- F. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - 1. Quenched and tempered medium carbon steel bolts, nuts and washers, complying with ASTM A325 or:
 - 2. Quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A490.
 - 3. Provide two ASTM F436 washers for all bolts.
 - 4. Provide beveled washers at connections of sloped/tapered sections.
- 5. Unless noted otherwise, high-strength fasteners shall be used for all nonstainless steel fasteners.
- G. Cast-in-Place Anchor Rods:
 - 1. ASTM F1554, Grade 36 with weldability supplement S1, galvanized, unless shown otherwise.
 - 2. Provide ASTM F436 washers at all nuts unless shown otherwise.
 - 3. Provide anchor bolt sleeves as required or as shown for location adjustment.
 - 4. Provide stainless steel anchors where shown on the Drawings or listed in another section.
- H. Galvanizing:
 - 1. Zinc coated hardware: ASTM A153.
 - 2. Fabrications: ASTM A123.
 - 3. Members designated as galvanized on the drawings or as directed by ENGINEER shall be galvanized after fabrication in accordance with ASTM A385. Weight of zinc coating shall not be less than 2.5 ounces per square foot of actual surface and have a coating thickness of 0.0042 inch. Coating weight will be subject to verification by ENGINEER. Thickness of coating will be measured by means of a magnetic thickness gauge.
 - 4. Each fabricated assembly shall be totally immersed in the galvanizing bath. The galvanizing procedure shall be such as to avoid distortion of the assembly. Straightening of members after galvanizing will not be permitted. Assemblies shall be held in the galvanizing bath until the temperature of the assembly is equal to the temperature of the bath. All deviations shall require approval by ENGINEER.
 - 5. Any galvanized surface which has the coating removed for any cause shall be touched up with a zinc-rich cold galvanizing compound so that the entire surface has a uniform coating of 2.5 ounces of zinc per square foot.
 - 6. Galvanized work shall be subject to inspection by ENGINEER at any time to ensure strict compliance with this specification. Any areas found to show defects or signs of improper galvanizing application will be rejected. Repairs shall be made by CONTRACTOR without additional cost to OWNER.
- I. Surface preparation and Finish:
 - 1. Steel: Where not indicated to be galvanized, steel shall be primed in the shop. Comply with Section 09 90 00, Painting.

2.3 ALUMINUM STAIR TREAD

- A. Extruded bearing bars positioned and locked by cross bars. Treads shall be manufactured with a defined visible abrasive nosing and end plates capable of welding or bolting to stair stringers.
- B. Material:
 - 1. All supports, cross members, etc. shall be aluminum

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- 2. Bearing bars: Alloy 6061-T6 or Alloy 6063-T6, conforming to ASTM B221.
- 3. Fasteners and fittings: ASTM A320, Type 316
 - a. Where stainless steel bolts are in contact with dissimilar metals provide insulating sleeves and phenolic washers to electrically isolate the bolts and nuts.

- C. Manufacturer:
 - 1. Grating Pacific
 - 2. Borden Metal Products
 - 3. Ohio Grating

2.4 FABRICATIONS

- A. Miscellaneous Framings and Supports:
 - 1. Fabricate units to the sizes, shapes, and profiles shown, or if not shown, of the required dimensions to receive the adjacent gratings, plates, tanks, doors, or other work to be retained by the framing.
 - 2. Except as otherwise shown, fabricate from structural shapes, plates, and bars of compatible material, all-welded construction, using mitered corners, welded brackets and splice plates, and a minimum number of joints for field connection. Cut, drill, and tap units to receive hardware and other items to be anchored to the work.
 - 3. Equip units with integrally welded anchors for casting into concrete or integrating into masonry. Furnish inserts for casting in, if units must be installed after concrete or grout is placed. Anchor spacing shall be 24" oncenter, unless otherwise shown.
 - 4. Galvanize where shown.
- B. Miscellaneous Fabricated Metals:
 - 1. The following additional items are listed as a guide. Some items on list may not be required, and list may not be all-inclusive. Submittal data for materials and products must be approved before they are incorporated in the work.
 - a. Access Walkway
 - b. Aluminum Stairways
 - c. Float Switch Supports
 - d. Lifting Eyes
 - e. Pipe Supports
 - f. Steel Bases and Anchors
 - g. Weir Plates
- C. Stainless Steel Fabrication: Following welding fabrication all stainless steel assemblies shall be cleaned, descaled and passivated in accordance with ASTM A380.
- D. Anchors, Fasteners, and Fittings: Provide zinc-coated carbon steel for steel fabrications, and stainless steel for aluminum and stainless steel fabrications, unless shown otherwise.
- E. Pipe Sleeves
 - 1. Provide as follows:
 - a. Hot-dip galvanized, Schedule 40 steel pipe sleeves where shown for piping passing through concrete or masonry.
 - b. Holes drilled with rotary drill may be provided in lieu of sleeves in existing walls.
 - c. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls.

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- d. Provide a rubber caulking sealant or a modular mechanical unit, as noted on the drawings, to form a watertight seal in the annular space between pipes and sleeves.
 - 1) Modular mechanical unit hardware to be zinc dichromate coated steel or galvanized steel

PART 3 - EXECUTION

3.1 FABRICATION

- A. General:
 - 1. Exposed Surfaces Finish: Smooth, sharp, well-defined lines.
 - 2. Provide necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
 - 3. Conceal fastenings where practical.
 - 4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
 - 5. Fabricate materials as specified.
 - 6. Weld connections, except where bolting is directed.
 - 7. Methods of fabrication not otherwise specified or shown shall be adequate for stress and as approved.
 - 8. Grind exposed edges of welds smooth on walkways, guardrails, handrails, stairways, channel door frames, steel column bases and where shown.
 - 9. Round sharp edges to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.
- B. Aluminum:
 - 1. Fabricate as shown, and in accordance with the Aluminum Association Standards and manufacturer's recommendations as approved.
 - 2. Grind smooth sheared edges exposed in finished work.

3.2 WELDING

A. General

- 1. Meet codes for Arc and Gas Welding in Building Construction of the AWS and AISC for techniques of welding employed, appearance, quality of welds made, and the methods of correcting defective work.
- 2. Welding Surfaces: Free from loose scale, rust, grease, paint, and other foreign material, except mill scale which will withstand vigorous wire brushing may remain.
- 3. A light film of linseed oil may likewise be disregarded.
- 4. Do not weld when temperature of base metal is lower than zero degrees F.
- 5. Finished members shall be true to line and free from twists.
- 6. Prepare welds and adjacent areas such that there is:
 - a. No undercutting or reverse ridges on the weld bead.
 - b. No weld spatter on or adjacent to the weld or any other area to be painted.
 - c. No sharp peaks or ridges along the weld bead.
- 7. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

B. Welding Operators: As specified in paragraph 1.3 of this section.

3.3 INSTALLATION

- A. Set units accurately in location, alignment, and elevation, level, plumb, true, and square, measured from established lines and levels. Brace or anchor temporarily in formwork where units are to be built into concrete, masonry, or similar construction.
- B. Anchor securely as shown or as required for the intended use, using concealed anchors wherever possible.
- C. Fit exposed edges accurately together to form tight, hairline joints. Do not weld, cut, or abrade the surfaces of galvanized or anodized units which are intended for bolted or screwed connections.
- D. Field Welding: Where field welding is necessary, grind joints smooth and touchup the shop paint. Comply with the applicable provisions of AWS D1.1 for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding.
- E. Field Coat all miscellaneous ferrous and steel metals per Specification Section 09 90 00, Painting, System 300.
- F. Where aluminum is in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces with epoxy coating with 15-mil minimum dry film thickness as specified in Section 09 90 00, Painting, System 305.

+ + END OF SECTION + +

SECTION 05 05 19

ANCHORS, INSERTS, AND DOWELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all post-installed anchors and inserts required to anchor parts of the Work to supporting concrete or masonry construction, and plaster. This section also includes adhesives for anchoring reinforcing dowels into existing concrete.

1.2 REFERENCES

- A. American Society for Testing and Materials
 - 1. ASTM A36, Standard Specification for Carbon Structural Steel.
 - 2. ASTM A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
 - 3. ASTM D746, Standard Test Method for Brittleness of Temperature of Plastics and Elastomers by Impact
 - 4. ASTM D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - 5. ASTM D1525, Standard Test Method for Vicat Softening Temperature of Plastics
- B. 2018 International Building Code (IBC)
- C. American Concrete Institute (ACI)
 - 1. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete
 - 2. ACI 355.4, Qualification of Post-installed Adhesive Anchors in Concrete

1.3 SYSTEM DESCRIPTION

- A. Provide the size, type, and length of anchor shown on the drawings or, if not shown, as specified in the detailed section of these specifications.
- B. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, toggle bolt, or concrete insert is not shown or specified, provide the size, length and capacity required to carry the design load times a minimum safety factor of 4.
- C. For equipment anchors, if the design load is not specified by the manufacturer, provide anchors of diameter no less than the diameter of the hole minus 3/16 inch. When the design load is not specified by the manufacturer, provide structural calculations in accordance with Section 01 61 00, General Product Requirements.

1.4 SUBMITTALS

Provo City

A. Submittal shall be in accordance with the requirements of 01 33 00, Submittal Procedures.

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- B. Product Data: Submit for approval copies of material certification, International Code Council (ICC) Evaluation Service reports (ESR), manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.
- C. Installer's Qualifications: When installing adhesive anchors subject to sustained tension loading or when specifically noted in the Drawings, submit for approval copies of the installer's qualifications certified by the ACI/CRSI Adhesive Anchor Installer Certification program.

1.5 QUALITY ASSURANCE

- A. Quality Control shall be in accordance with the requirements of 01 45 00, Quality Control.
- B. Post-installed concrete anchors shall be ICC approved for seismic applications in cracked concrete and prequalified in accordance with ACI 355.2 or ACI 355.4.

PART 2 - PRODUCTS

2.1 ANCHOR BOLTS

- A. Nonsubmerged Use in areas of wet use, washdown areas, or areas outside heated buildings:
 - 1. Stainless steel Type 316, unless otherwise shown.
 - 2. Diameter, Length and Bend Dimensions: As required by equipment or machinery manufacturer. Unless otherwise required, provide 3/4 inch minimum diameter by 12 inches long and other geometry as shown.
 - 3. Furnish ASTM A320 nuts and washers of same material for each bolt, unless otherwise shown.
 - 4. Provide sleeves as required or as shown for location adjustment.
- B. Submerged Use:
 - 1. Stainless steel Type 316, unless otherwise specified.
 - 2. Submerged use is defined as any connection 1 foot 6 inches below the normal water surface elevation in a water holding basin.
 - 3. As specified for non-submerged use, for equipment, machinery or other connections except as follows:
 - a. Coating of anchor bolt threads is not required.
 - b. Where threads are covered with fusion bonded coating, provide nut of proper size to fit and provide connection of equal strength to embedded bolt.
- C. For anchoring fabricated metalwork, structural steel, or other components where connections will be protected or dry:
 - 1. Galvanized Steel, 36 ksi, minimum.
 - 2. Minimum Size: 3/4 inch diameter by 12 inches long, unless otherwise shown.
 - 3. At base plates with grout pads, furnish two nuts and two washers per bolt of same material as bolt, unless otherwise shown.

2.2 ANCHOR BOLT SLEEVE

A. High Density Polyethylene Plastic:

- 1. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.
- 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
- 3. Material requirements shall conform to the following:
 - a. Plastic: High density polyethylene.
 - b. Density: 0.956, ASTM D1505.
 - c. Vicant Softening Point: 256°F, ASTM D1525
 - d. Brittleness Temperature: 180°F, ASTM D746
- B. Fabricated Steel Sleeve:
 - 1. Material: ASTM A36 steel
 - 2. Dimensions, welding, and sizes as shown

2.3 STAINLESS STEEL FASTENERS LUBRICANT (ANTISEIZING)

- A. Provide for stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners.
- B. Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper as manufactured by:
 - 1. Loc Tite Co., Permatex.
 - 2. Or equal

2.4 CONCRETE INSERTS

- A. For vertical support of grating or floor plate, provide cast-in metal fabrications as shown.
- B. Except as permitted below, or as otherwise shown, provide malleable iron inserts for hanging piping and conduit from concrete ceilings and soffits. Comply with Federal Specification WW-H-171-E (Type 18). Provide those recommended by the manufacturer for the required loading.
- C. Obtain inserts in sufficient time so as not to delay concrete or masonry work.
- D. Product and Manufacturer: Provide inserts of one of the following:
 - 1. Figure 282, as manufactured by Anvil/Grinnell.
 - 2. Sharktooth Insert, as manufactured by Hohmann and Barnard, Incorporated
 - 3. No equal

2.5 ADHESIVE (EPOXY) ANCHORS AND DOWELS

- A. Provide adhesive anchors where specifically shown and where adhesive anchors are allowed. Unless otherwise shown, adhesive anchors are allowed for anchoring:
 - 1. Supports for pipe, conduit, and electrical boxes, devices, and panels, on floors and walls
 - 2. Handrails, guardrails, sunshades, stairs,
 - 3. Fixtures and equipment on floors and walls, and
 - 4. Single pipes and conduits <2 inches in diameter to ceilings and soffits.
- B. Adhesive shall be epoxy resin. Vinylester resin anchors are NOT allowed.

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- C. Product and Manufacturer: Provide one of the following:
 - 1. Installation to Concrete:
 - a. HIT-HY 200 as manufactured by Hilti, Inc.
 - b. SET-3G as manufactured by Simpson Strong-Tie, Inc.
 - c. Or approved equal meeting ACI 355.4.
 - 2. Installation to solid-grouted Masonry:
 - a. HIT-HY 270 as manufactured by Hilti, Inc.
 - b. SET as manufactured by Simpson Strong-Tie, Inc.
 - c. Or approved equal.

2.6 EXPANSION ANCHORS

- A. Provide expansion anchors only where specifically shown or approved by ENGINEER. Unless otherwise shown, and except as noted below, expansion anchors are allowed for anchoring:
 - 1. Supports for pipe, conduit, and electrical boxes, devices, and panels, to floors and walls.
 - 2. Handrails, guardrails, and sunshades.
 - 3. Fixtures and equipment which have no moving parts, to floors and walls.
- B. Expansion anchors are NOT allowed in any submerged or chemical containment areas.
- C. Leveling nuts shall not be used with expansion anchors. If leveling nuts are required, provide adhesive anchors, unless otherwise shown.
- D. Wedge anchors: Provide one of the following:
 - 1. Installation to Concrete:
 - a. Hilti Kwik Bolt TZ by Hilti, Inc.
 - b. Strong-Bolt 2 by Simpson Strong-Tie, Inc.
 - c. Or approved equal meeting ACI 355.2.
 - 2. Installation to solid-grouted Masonry:
 - a. Hilti Kwik Bolt-3 by Hilti, Inc.
 - b. Wedge-All by Simpson Strong-Tie, Inc.
 - c. Or approved equal.
- E. Drop-in anchors, only where specifically shown on the drawings: Provide one of the following:
 - 1. HDI by Hilti, Inc.
 - 2. Drop-In by Simpson Strong-Tie, Inc.
 - 3. Or equal.

2.7 SCREW ANCHORS

- A. Provide screw anchors only where specifically shown. Provide ICC approved screw anchors suited for seismic and cracked concrete applications.
- B. Installation to Concrete or Masonry:
 - 1. KH-EZ by Hilti, Inc.
 - 2. Titen HD by Simpson Strong-Tie, Inc.
 - 3. Or approved equal

2.8 TOGGLE BOLTS

- A. Provide toggle bolts only where specifically shown, to fasten single pipes and conduits <1 inch and equipment weighing less than 50 lbs (4-bolts required) to hollow walls.
- B. Provide spring-wing toggle bolts, with two-piece wings, carbon steel bolts with zinc coating in accordance with Federal Specification FF-S-325.
- C. Product and Manufacturer: Provide toggle bolts of one of the following:
 - 1. The Rawlplug Company, Incorporated.
 - 2. Haydon Bolts, Incorporated.
 - 3. Or equal.

2.9 OTHERS

A. Powder actuated fasteners and other types of anchors not specified herein shall not be used, unless approved by ENGINEER.

2.10 ACCESSORIES

A. Provide Belleville washers, or approved equal, at anchorage connections used to transfer anchorage loads at sheet metal equipment housings.

PART 3 - EXECUTION

3.1 INSTALLATION OF ANCHORS

- A. Obtain anchor bolts in sufficient time so as not to delay concrete or masonry work.
- B. Adhesives shall be stored and installed at the service temperature ranges recommended by the manufacturer.
- C. Locate and accurately set the anchor bolts using templates or other devices as necessary.
- D. Protect threads and shank from damage during installation of equipment and structural steel.
- E. Post-installed anchors are NOT acceptable substitutes for cast-in-place anchor bolts.
- F. Assure that embedded items are protected from damage and are not filled in with concrete.
- G. Unless otherwise shown, the minimum diameter of anchor bolts for structural steel is 3/4 inch, and for other applications, 3/8 inch.
- H. Unless otherwise shown, provide the following minimum embedment, where "d" is the nominal anchor diameter:
 - 1. Cast-in-place anchors: 12d.
 - 2. Adhesive anchors: 12d.
 - 3. Expansion anchors: 8d.

- I. Unless otherwise shown, provide a minimum edge distance equal to six times the bolt diameter for adhesive anchors, eight times the bolt diameter for expansion anchors and a bolt spacing equal to twelve times the bolt diameter.
- J. Concrete shall have a minimum age of 21 days at the time of post-installed anchor installation.
 - 1. Concrete temperature at the time of adhesive anchor installation shall be at least 50 degrees F.
- K. Existing reinforcing bars in the concrete structure may conflict with specific anchor locations. Unless noted on the Drawings that the bars can be cut, the CONTRACTOR shall review the existing structural drawings and shall undertake to locate the position of the reinforcing bars at the locations of the concrete anchors by ferroscan, ground penetrating rebar (GPR), x-ray, chipping or other means.
- L. Drilling equipment used and installation of post-installed anchors shall be in accordance with the manufacturer's printed instructions.
- M. For the adhesive and expansion anchors, CONTRACTOR shall comply with the manufacturer's printed installation instructions on the drilled hole diameter and depth.
- N. CONTRACTOR shall properly clean out the hole utilizing a wire brush and compressed air in accordance with the manufacturer's printed installation instructions to remove all loose material from the hole, prior to installing adhesive or expansion anchors. Drilled and cleaned anchor holes shall be protected from contamination until the anchor is installed. A drilled anchor hole shall be re-cleaned assuming the hole was just drilled, if in the opinion of ENGINEER or Inspector that the hole has become contaminated after initial cleaning.
- O. Unless otherwise indicated by the manufacturer, adhesive shall be dispensed through a tube or cartridge extension, beginning at the maximum depth of the hole and withdrawn as adhesive is injected, followed by insertion and rotating the anchor to the specified depth. Where necessary, spaces around anchors at the surface shall be sealed at horizontal to vertically overhead locations to prevent loss of the adhesive during curing.
- P. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.
- Q. Installed anchors shall be securely fixed in-place to prevent displacement. Unless shown otherwise on the Drawings, anchors shall be installed perpendicular to the concrete surface.
- R. Reinforcing adhesive dowel bars or all-threaded adhesive bars shall not be bent after being adhesively embedded in hardened, sound concrete.
- S. In lieu of the use of stacked standard washers, if threads of an anchor bolt protrude beyond the attachment, the installers shall use a fabricated filler plate of equal or greater size of the washer. Hole on the filler plate shall be 1/16" (or 2 to 3 mm) greater than the bolt size. Coat as appropriate in accordance with the material and installation location requirements.

3.2 FIELD QUALITY CONTROL

- A. Anchors shall be installed by qualified personnel in accordance with the manufacturer's printed installation instructions. Installation of adhesive anchors shall be performed by personnel trained to install adhesive anchors.
- B. Installation of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program.
- C. CONTRACTOR shall employ a special inspector to perform field inspection services in accordance with Chapter 17 of the IBC for all post-installed anchors.
 - 1. The special inspector must be periodically on the jobsite during post-installed anchor installation.
 - 2. Adhesive anchors installed to resist sustained tension loads shall be continuously inspected during installation by an inspector specially approved for that purpose by the building official.
- D. CONTRACTOR shall employ a testing laboratory to perform field quality testing of installed adhesive anchors. A minimum of 10% of randomly selected adhesive anchors and reinforcing dowel bars greater than 3/8-inch diameter are to be tension tested to the least of 50% of expected adhesive ultimate bond strength or 80 percent of steel yield strength of the anchor rod. Maintain the proof load at the required load level for a minimum of 10 seconds.
 - 1. Tension testing shall be performed in accordance with ASTM E488.
 - 2. The independent testing laboratory shall submit an anchorage testing plan for approval to ensure the testing requirements are fulfilled.
 - 3. If failure of more than 5 percent of the tested anchors or reinforcing dowel bars occurs, CONTRACTOR will be required to pay for the costs involved in testing the remaining 90%.
 - a. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
- E. CONTRACTOR shall correct improper workmanship, remove and replace, or correct as instructed by the ENGINEER, all anchors or bars found unacceptable or deficient, at no additional cost to the OWNER.
- F. The independent testing and inspection agency shall complete a report on each area. The report should summarize the observations made by the inspector and be submitted to ENGINEER.
- G. Provide access for the testing agency to places where Work is being produced so that required inspection and testing can be accomplished.

+ + END OF SECTION + +

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SECTION 05 10 00

STRUCTURAL STEEL

<u> PART 1 - GENERAL</u>

1.1 SUMMARY

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish and install structural steel, including connections, surface preparation and shop priming.
 - 2. Structural steel is that Work defined in AISC "Code of Standard Practice", Section 2, and as shown on the Drawings. The Work also includes:
 - a. Providing openings in and attachments to structural steel to accommodate the Work under this and other sections and providing for the structural steel all items such as anchor bolts, studs and all items required for which provision is not specifically included under other sections.
- B. Coordination:
 - 1. Review installation procedures under other sections and coordinate the Work that must be installed with or attached to the structural steel.

1.2 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of 01 33 00, Submittal Procedures.
- B. Shop Drawings: Submit for approval the following:
 - 1. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures and diagrams showing the sequence of erection.
 - a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
 - b. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - 2. Copies of manufacturer's specifications and installation instructions for products listed below. Include laboratory test reports and other data as required to show compliance with the Contract Documents.
 - a. Structural steel of each type, including certified copies of mill reports covering the chemical and physical properties.
 - b. High strength bolts of each type, including nuts and washers.
 - c. Unfinished bolts and nuts.
 - d. Shop primer and touch-up field primer paint in accordance with Section 09 90 00, Painting.

1.3 QUALITY ASSURANCE

A. Quality Control shall be in accordance with the requirements of 01 45 00, Quality Control.

- B. Reference Standards and Codes: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ASTM A36, Standard Specification for Carbon Structural Steel
 - 2. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold Finished
 - 4. ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 5. ASTM A153, Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 6. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile strength
 - 7. ASTM A325, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - 8. ASTM A385, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
 - 9. ASTM A490, Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
 - 10. ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - 11. ASTM A992, Standard Specification for Structural Steel Shapes
 - 12. ASTM A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 13. ASTM F436, Standard Specification for Hardened Steel Washers
 - 14. ASTM F592, Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
 - 15. ASTM F1554, Standard Specification for Anchor Bolts
 - 16. ASTM F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength
 - 17. AWS D1.1, Structural Welding Code
 - 18. AREA, Manual of Railway Engineering
 - 19. AISC, Manual of Steel Construction
 - 20. AISC 303, Code of Standard Practice for Steel Buildings and Bridges
 - 21. AISC 360, Specifications for Structural Steel Buildings
 - 22. Specifications for Structural Joints Using High-Strength Bolts, RCSC Specification
- C. Design of Members and Connections:
 - 1. All details shown on the Drawings are typical; similar details apply to similar conditions, unless otherwise shown on the Drawings or specified. Verify dimensions at the site without causing delay in the Work.
 - 2. Examine conditions under which structural steel is to be provided, and notify ENGINEER, in writing, of unsatisfactory conditions existing or whenever design of members and connections may not be clearly shown on the Drawings. Do not proceed with the Work until unsatisfactory conditions or deficiencies have been corrected in a manner acceptable to ENGINEER.
- D. Source Quality Control:
 - 1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
 - 2. Steel fabricator shall have at least 5 years experience in the fabrication of structural steel for projects substantially similar to those required for this project.

- 3. Fabrication shall be performed by a structural steel fabricating plant possessing a current certificate from AISC stating that the plant satisfies the requirements for certification for Certified Building Fabricator of the AISC Quality Management Systems Certification Program. The plant shall maintain this certification for the entire time fabrication for this project is being performed.
- E. Qualifications for Welding Work:
 - 1. Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code" D1.1, Section 5, Qualification.
 - 2. Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months. Ensure that all certifications are kept current.
 - 3. All welds will be subject to visual inspection. Where visually deficient welds are observed, the welds will be tested using non-destructive methods by a certified testing laboratory. If welds are found to be satisfactory, OWNER will pay for testing. Where welds are found unacceptable or deficient, the CONTRACTOR will pay for testing, correct improper workmanship, remove and replace, or correct as instructed. Responsibility belongs to CONTRACTOR to pay for all corrections and subsequent tests required to confirm the integrity of the weld.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Product delivery storage and handling shall be in accordance with Section 01 66 10, Storage, Handling, and Delivery.
- B. Deliver materials to the site at such intervals to ensure uninterrupted progress of the Work.
 - 1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-inplace concrete or masonry, in ample time to not delay that Work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wide Flange Sections: ASTM A992 Grade 50, tensile strength or 65 ksi & yield strength of 65 ksi.
- B. Steel Pipe Columns: ASTM A53 Grade B, tensile strength of 60 ksi and yield strength of 35 ksi.
- C. Hollow Structural Sections (HSS): ASTM A500 Grade B, tensile strength of 60 ksi and yield strength of 42 ksi.

- D. Plates, Angles, Channels, and S Shapes: ASTM A36, except where other type steel is shown on the Drawings. A36 tensile strength of 58-80 ksi and yield strength of 36 ksi.
- E. Crane Rails: As shown on the Drawings and as noted in the AISC Manual.
 - 1. Provide rails with tight end joints suitable for crane service with joint bars matching the rail sections, joint bar bolts and nuts complying with ASTM A325 with AREA alloy steel spring washers, and fixed or floating type rail clamps, as required to suit the conditions shown on the Drawings.
- F. Headed Studs and Deformed Bar Anchors:
 - 1. Studs: ASTM A108, complying with AWS Code Section 7, Type B; minimum yield strength 50,000 psi, minimum tensile strength 60,000 psi.
 - a. Uniform diameter.
 - b. Heads: Concentric and normal to shaft.
 - c. Weld end: Chamfered and solid flux.
 - 2. Deformed anchor bars: ASTM A1064, complying with AWS Code Section 7 Type C. Minimum yield strength 70,000 psi. Minimum tensile strength 80,000 psi.
 - a. Straight, unless indicated otherwise.
 - b. Solid flux.
 - 3. After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.
- G. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - 1. Quenched and tempered medium carbon steel bolts, nuts and washers, complying with ASTM A325 or:
 - 2. Quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A490.
 - 3. ASTM F3125 high-strength bolts shall be used for twist-off / tension-controlled bolts.
 - 4. Provide ASTM F436 washers for all bolts in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
 - 5. Provide beveled washers at connections of sloped/tapered sections.
 - 6. Unless noted otherwise, high-strength fasteners shall be used for all non-stainless steel fasteners. Pre-tension all high-strength fasteners unless noted otherwise. Pre-tension any connection with designation (SC) slip critical. Slip critical (SC) connections must be free of paint, oil, or other materials that reduce friction at contact surfaces. Galvanized or lightly rusted surfaces are acceptable.
- H. Cast-in-Place Anchor Rods:
 - 1. ASTM F1554, Grade 36 with weldability supplement S1 for threaded rods galvanized.
 - 2. Provide ASTM F436 washers at all nuts.
 - 3. Embedded anchors shall be headed with a standard square plate washer tack welded to the anchor head, unless a larger washer is shown otherwise in the Drawings.
 - 4. Only provide threads at the top of the anchor as required for connections.
- I. Common Bolts:
 - 1. ASTM A307, Grade A for headed bolts galvanized.
- J. Stainless Steel Fasteners:

- 1. ASTM F593 Type 304 or 316 stainless steel with matching nut and washer for nonliquid containing (dry) structures.
- 2. ASTM F593 Type 316 stainless steel for liquid-containing structures.
- K. Electrodes for Welding: E70XX complying with AWS D1.1 Section 8.
- L. Galvanizing:
 - 1. Zinc coated hardware: ASTM A153.
 - 2. Fabrications: ASTM A123.
 - 3. Members designated as galvanized on the drawings or as directed by ENGINEER shall be galvanized after fabrication in accordance with ASTM A385. Weight of zinc coating shall not be less than 2.5 ounces per square foot of actual surface and have a coating thickness of 0.0042 inch. Coating weight will be subject to verification by ENGINEER. Thickness of coating will be measured by means of a magnetic thickness gauge.
 - 4. Each fabricated assembly shall be totally immersed in the galvanizing bath. The galvanizing procedure shall be such as to avoid distortion of the assembly. Straightening of members after galvanizing will not be permitted. Assemblies shall be held in the galvanizing bath until the temperature of the assembly is equal to the temperature of the bath. All deviations shall require approval by ENGINEER.
 - 5. Any galvanized surface which has the coating removed for any cause shall be touched up with a zinc-rich cold galvanizing compound so that the entire surface has a uniform coating of 2.5 ounces of zinc per square foot.
 - 6. Galvanized work shall be subject to inspection by ENGINEER at any time to ensure strict compliance with this specification. Any areas found to show defects or signs of improper galvanizing application will be rejected. Repairs shall be made by CONTRACTOR without additional cost to OWNER.
- M. Surface preparation and Finish:
 - 1. Steel: Where not indicated to be galvanized, steel shall be primed in the shop per Section 09 90 00, Painting. Exposed, non-galvanized, steel shall be coated per Section 09 90 00, Painting.

2.2 FABRICATIONS

- A. Shop Fabrication and Assembly:
 - 1. General:
 - a. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC, Manual of Steel Construction, and as shown on the shop drawings. Provide camber in structural members as shown on the drawings.
 - b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.
 - c. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
 - 2. Field Connections:
 - a. All field connections, unless otherwise specified below or noted, shall be made with high strength bolts, and shall be bearing type connections.
 - b. Field welding may be used only where noted or approved by ENGINEER.

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3. High-Strength Bolted Construction:

- a. Install high-strength threaded fasteners in accordance with AISC "Specification for Structural Joints Using High-Strength Bolts" (RCSC).
- 4. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - a. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
- 5. Shear Connectors: Install stud shear connectors in accordance with AWS D1.1 Section 4, and as recommended by the manufacturer.
- B. Bracing:
 - 1. Bracing shall have a minimum two bolt connection, or a shop welded connection of equivalent strength.
 - 2. Vertical bracing and knee braces connecting to columns shall be on the centerline of the columns, unless otherwise noted.
 - 3. Knee braces shall be at 45 degree angle, unless shown on the Drawings or noted.
 - 4. All gussets shall be minimum 3/8 inch thick, unless otherwise shown on the Drawings.
- C. Columns: Column shafts shall have "finished" bearing surfaces at the base and at all splice lines.
- D. Hollow Structural Sections (HSS): HSS shall be properly sealed to protect the internal surfaces.
- E. Holes and Appurtenances for Other Work:
 - 1. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members, as shown on the shop drawings. If large block-outs are required and approved by the ENGINEER, the webs shall be reinforced to develop specified shears. Provide threaded nuts welded to framing, and other specialty items as shown on the Drawings to receive other work.
 - 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
 - 3. Refer to paragraph 1.1.B, above, for the requirements of coordination with others.
- F. Grind smooth all rough welds and sharp edges shall be ground to approximately 1/8 inch radius.

2.3 WELDING

- A. Comply with AWS Code, and other requirements indicated herein, for all welding, techniques of welding employed, appearance and quality of welds, and methods used to correct defective work.
 - 1. Qualify joint welding procedures or test in accordance with AWS qualification procedures.
- B. Test and qualify welders, welding operators and tackers in compliance with AWS Code for position and type of welding to which they will be assigned.

- 1. Conduct tests in presence of approved testing agency.
- 2. Certification within previous 12 months will be acceptable, provided samples of the welder's work are satisfactory.

- C. Before Starting Welding:
 - 1. Carefully plumb and align members in compliance with specified requirements.
 - 2. Fully tighten bolts.
 - 3. Comply with Section 5 of AWS Code for assembly and surface preparation.
 - 4. Preheat base metal to temperature stated in AWS Code.
 - a. When no preheat temperature is given in AWS Code and base metal is below 50° F, preheat base metal to at least 70 degrees F.
 - b. Maintain temperature during welding.
 - c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 inches, whichever is greater, to specified preheat temperature.
 - d. Maintain this temperature during welding.
 - 5. Each welder shall use identifying mark at welds.
- D. Make flange welds before making web welds.
- E. Where groove welds have back-up plates, make first three passes with 1/8 inch round electrodes.
 - 1. Use backup plates in accordance with AWS Code, extending minimum of 1 inch either side of joint.
- F. Flame cut edges of stiffener plates at shop or field butt weld. Do not shear.
- G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.
- H. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS Code.
- I. Do not perform welding when ambient temperature is lower than 0 degrees F or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.
- J. Headed Studs and Deformed Bar Anchors:
 - 1. Automatically end welded in accordance with the AWS Code and manufacturer's recommendations.
 - 2. Fillet welding of headed studs and deformed bar anchors is not allowed unless approved by ENGINEER.
- K. Test in-place studs in accordance with requirements of AWS Code to ensure satisfactory welding of studs to members.
 - 1. Replace studs failing this test.
- L. When headed stud-type shear connectors are to be applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding. Do not shop paint or galvanize metal surfaces to receive field applied studs.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which structural steel Work is to be installed, and notify ENGINEER, in writing, of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 ERECTION

- A. General: Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.
- B. Surveys: Provide services of a registered surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices before steel erection proceeds. Discrepancies shall be reported immediately to ENGINEER, in writing. Do not proceed with erection until corrections have been made, or until compensating adjustments to the structural steel Work have been agreed upon with ENGINEER.
- C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.
- D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with OSHA requirement of a tightly planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which Work is performed.
- E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place Work.
 - 1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.
 - a. Refer to Section 05 05 19, Anchors, Inserts and Dowels, of these Specifications for anchor bolt installation requirements.
- F. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.
 - 2. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.
 - 3. Place non-shrink grout between bearing surfaces and bases or plates as specified in Section 03 60 00, Grout. Finish exposed surfaces, protect installed materials, and allow curing in strict compliance with the manufacturer's instructions, or as otherwise required.
 - 4. Leveling plates and wood wedges will not be permitted.

- G. Field Assembly: Set structural frames accurately to the lines and elevations as shown on the Drawings. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of the structure within tolerances as specified in AISC Manual. For members requiring accurate alignment, clip angles, lintels and other members shall be provided with slotted holes for horizontal adjustment at least 3/8 inch in each direction, or more when required.
 - 2. Splice members only where shown on the Drawings or specified.
- H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
- I. Comply with AISC Manual for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
 - 1. Do not enlarge unfair holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- J. Gas Cutting: Do not use gas cutting torches for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to ENGINEER. Finish gas-cut sections equal to a sheared appearance when permitted.
- K. Crane Runways:
 - 1. Install runways complete with rails, crane stops and other required items. Set and adjust the gage, alignment and elevation of the crane rails to tolerances of AISC for crane rails, unless otherwise shown on the Drawings. Stagger joint locations in opposite rails. Rail joints shall, also, be at least 24 inches from crane girder joints. Provide flush joints at the top of all crane rails.
- L. Touchup Painting:
 - 1. Unless otherwise specified below, comply with all requirements of touch-up painting specified in Section 09 90 00, Painting.
 - 2. Immediately after erection, clean field welds, bolted connections, and all damaged and abraded areas of the shop paint. Apply paint to all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness as specified in Section 09 90 00, Painting.

3.3 FIELD QUALITY CONTROL

- A. The CONTRACTOR will employ a testing laboratory approved by the ENGINEER to perform field quality control testing to inspect and to perform tests and prepare test reports in accordance with IBC section 1705.2 and AISC 360.
 - 1. The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state all deviations.
 - 2. Provide access for the testing agency to places where structural steel Work is being fabricated or produced so that required inspection and testing can be accomplished.
 - 3. The testing agency may inspect structural steel at the plant before shipment; however, ENGINEER reserves the right, at any time before Final Acceptance, to reject material not complying with specified requirements.

B. Correct deficiencies in structural steel Work that inspection and/or laboratory test reports indicate do not comply with the Specifications. Perform additional tests, as may be required to reconfirm any non-compliance of the original Work, and as may be required to show compliance of corrected Work.

+ + END OF SECTION + +

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide and install coatings on all exposed surfaces as indicated herein, in other Specification Sections, and on the Drawings.

1.2 QUALITY ASSURANCE

- A. Experience: Both Coatings Manufacturer and Coatings Installer shall have a minimum 5 years' experience in production and application, respectively, of specified products. Coatings Installer shall be approved and endorsed, in writing, by Coatings Manufacturer.
- B. Regulations: Meet federal, state, and local requirements which apply to the work, including, but not limited to those regulations limiting the emission of volatile organic compounds.
- C. Coatings Manufacturer Recommendations: Coatings Installer shall follow all recommendations of the Coatings Manufacturer regarding storage, handling, surface preparation, application of coatings, recoat times, environmental conditions during storage, preparation and application of coatings, and all other Coatings Manufacturer recommendations.
- D. Warranty: Both Coatings Manufacturer and Coatings Installer shall provide a 1-year complete replacement warranty for all coatings. Manufacturer shall provide 5-year warranty for long-term performance of coatings in addition to 1-year warranty.

1.3 SUBMITTALS

- A. Shop Drawings: Coatings Manufacturer shall submit for approval the following:
 - 1. Copies of Manufacturer's technical information and application instructions for each material proposed for use. Specify exactly which product is being proposed for each coating type (as specified below). This may be accomplished through a reference table along with information on the various products, or by a separate, tabbed section with information on products being submitted for each system in a separate tab of a binder. Submittal of general Manufacturer's literature without detailing which product is proposed for each paint system will be unacceptable.
 - 2. Copies of Manufacturer's complete color charts for each coating system.
 - 3. Letter from the Coatings Manufacturer approving and endorsing Coatings Installer.
 - 4. Letter from Coatings Manufacturer stating that volatile organic compounds (VOCs) meet all Federal, State and Local requirements.
 - 5. Furnish copies of the final, approved submittal to the Coatings Installer so that it is clear which product is to be used for which each system.
- B. Reference Samples:

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1. Provide reference samples of paint colors and textures as required by the ENGINEER. Reference samples will show the color and texture of the final paint to be applied and shall be approved by the ENGINEER prior to painting. Reference samples should be applied to similar substrates to the final surfaces to be painted. If ENGINEER chooses to forego reference samples, CONTRACTOR must receive the allowance to forego reference samples before painting begins or all painted surfaces will be re-painted at the ENGINEER's discretion and at no additional cost to the OWNER.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection: Protect all pre-coated items from coating damage during shipping.
- B. Store products in accordance with Manufacturer's directions.
- C. Store products in a neat, orderly fashion. Protect products from damage. Protect storage area from damage from stored products.

PART 2 - PRODUCTS

2.1 PRODUCT AND MANUFACTURER:

A. Provide coating types as listed in the following table. The systems referenced in the table are those provided by TNEMEC and Sherwin-Williams. If manufacturers other than TNEMEC or Sherwin Williams are desired, the CONTRACTOR shall submit equivalent paint systems.

COATING TYPE	DESCRIPTION	Sherwin Williams Series	TNEMEC SERIES
Clear Polyamine Epoxy	Clear Polyamine Epoxy, high solids, moisture resistant, designed as a one-coat wood sealer.	GP3477	Series 201, Epoxoprime
Acrylic Filler	Waterborne Cementitious Acrylic designed for application on porous surfaces such as rough-faced concrete masonry units	CementPlex 875	Series 130, Envirofill
Interior Acrylic Latex	Single component, finish as required	ProMar 200	N/A
Industrial Acrylic	Single component, high density acrylic finish for interior, exterior surfaces	Pro Industrial High Performance Acrylic	Series 1029
Interior Latex Primer/ Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum wallboard/plaster. Capable of providing uniform seal and suitable for use with specified finish coats.	ProMar 200 Primer	Series 115

Exterior Acrylic Latex Primer/Sealer	Capable of providing uniform seal and suitable for use with specified finish coats.	Extreme Bond Latex Primer	Series 1028
Polyamine Epoxy Sealer	Waterborne Polyamine Epoxy, penetrating, flexible and low-odor primer designed for sealing porous substrates.	Multi-Purpose Acrylic Primer	Series 151, Elasto-Grip FC
Acrylate	Modified Waterborne Acrylate designed for application on porous surfaces such as rough-faced concrete masonry units or wood surfaces. Flexible and breathable, moisture and UV resistant. Matte Finish	Loxon XP	Series 156, Enviro-crete
Polyamidoamine Epoxy	Polyamidoamine Epoxy designed for use on steel or other ferrous metals not in contact with potable water but submerged or immersed in wastewater or non-potable water.		Series N69, V69 or L69 (type per local VOC regulations), Hi-Build Epoxoline II
	Polyamidoamine Epoxy designed for use on steel or other ferrous metals in contact with potable water.	Macropoxy 5500	Series N140, L140 or V140 (type per local VOC regulations), Pota-Pox Plus
Polyurethane	Aliphatic Acrylic Polyurethane designed for exterior weathering, abrasion and corrosion resistance	HS Polyurethane 250 or Waterbased Acrolon	Series 1095, Endura-Shield
Silane Water Repellent Sealant	Silane/Siloxane penetrating water repellent blend designed for application on above-grade concrete, stucco, block, masonry and stone surfaces	Loxon 7% Siloxane	Series 636, Dur A Pell 20
Wood Sealer / Stain	Single component, 250 g/l wood stain in clear or standard colors	Minwax 250	
Wood Varnish Finish	Single component polyurethane varnish	Minwax	

B. All coatings used shall comply with Federal, State and local VOC limits based on application location.

2.2 COLOR

A. Color Pigments: Pure, nonfading, lead-free applicable types to suit the substrates and service indicated.

- B. Provide colors as described in the drawings or specifications, or as selected by ENGINEER from standard color palette. For piping system colors, reference pipe schedule.
- C. Where existing colors are to be matched or satisfactory color is not available from standard color palette, provide custom-mixed colors.
- D. Provide samples of each color on the substrate to be coated for approval by the ENGINEER prior to beginning coating application.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Coatings Installer shall prepare all surfaces to be painted in strict accordance with Coatings Manufacturer's recommendations.
- B. Coatings Manufacturer representative shall observe Coatings Installer's methods of preparing surfaces and approve of the work prior to Coatings Installer beginning coating installation. If, after a period of time, Coatings Manufacturer is satisfied with Coatings Installers methods, Coatings Manufacturer can allow Coatings Installer to proceed without inspection following surface preparation. Coatings Manufacturer and installer will still both be held equally accountable for any coatings failure.
- C. Wood surface preparation
 - 1. Coatings Installer shall clean and prepare all wood surfaces in accordance with the Coating Manufacturer's recommendations. Patching may be required where approved by the Engineer. All joints in wood members including trim, siding, soffits, and joints between wood and dissimilar materials shall be filled with joint sealant prior to coating.

3.2 PROTECTION

- A. Protect all adjacent surfaces from overspray, dripping or other transfer of coatings not intended for those surfaces. Use masking, tape, drop cloths, plastic and other protective materials as appropriate.
 - 1. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, stainless steel surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.
 - 2. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors, fan housings, etc. to prevent coatings from falling inside.
 - 3. Correct all damages by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.
- B. Completely remove all masking, tape, drop cloths, plastic and other protective materials within 48 hours of completion of application of finish coat. Take special care to remove masking and plastic which cover tank vent openings, HVAC registers, vents, motor vents, and other areas where airflow is critical to proper operation.

3.3 APPLICATION

A. Paint all exposed surfaces not specifically excluded in 3.3.C, below. Provide and install Coatings in accordance with the following Table, unless otherwise specified in other Sections:

COATING SYSTEM NO.	SURFACE TO BE COATED	PRIMER COATING	NO OF PRIMER COATS	PRIME COAT THICKNESS (EACH COAT)	FINISH COATING	IO OF INISH OATS	FINISH COAT THICKNESS (EACH COAT)
100	Concrete Masonry Units (Interior)	Acrylic Filler	1	70 SF/Gal Applicatio n Rate	Acrylate	2	135 SF/Gal Application Rate
101	Concrete Masonry Units (Exterior)	Silane Waterproofing Sealant	1	250 SF / Gal Applicatio n Rate	None		
102	Concrete Roof Slab (Exterior)	Silane Waterproofing Sealant	1	250 SF/Gal Applicatio n Rate	None		
200	Wood (Interior and Exterior)	Polyamine Epoxy	1	250 SF/Gal Applicatio n Rate	Acrylate	2	135 SF/Gal Application Rate
201	Wood (Interior, where noted)	Wood Sealer	1	250 SF/Gal Applicatio n Rate	Wood Finish	1	350 SF/Gal Application Rate
202	Gypsum Board (Interior)	Interior Latex Primer/Sealer	1	350 SF/Gal Applicatio n Rate	Interior Acrylic Latex (Semigloss)	2	400 SF/Gal Application Rate
300	Exposed Ferrous Pipe Systems and Exposed Steel Items	Polyamidoamine Epoxy	2	4-6 MDFT	Polyurethane	2	2-3 MDFT
301	Exposed, Non-metallic Pipe Systems	Exterior Latex Primer/Sealer	1	3-5 MDFT	Industrial Acrylic (Semigloss)	2	3-5 MDFT
302	Immersed Ferrous Pipe Systems and Steel Items	Polyamidoamine Epoxy*	1	6-10 MDFT	Polyamidoamine Epoxy*	1	6-10 MDFT
303	Immersed Non-metallic Pipe Systems	Latex Primer/Sealer*	1	4-6 MDFT	Industrial Acrylic (Semigloss)*	1	4-6 MDFT

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COATING SYSTEM NO.	SURFACE TO BE COATED	PRIMER COATING	NO OF PRIMER COATS	PRIME COAT THICKNESS (EACH COAT)	FINISH COATING	IO OF INISH OATS	FINISH COAT THICKNESS (EACH COAT)
304	Buried Ferrous and Steel Items	Polyamidoamine Epoxy	1	8-10 MDFT	Polyamidoamine Epoxy	1	8-10 MDFT
305	Aluminum Surfaces in Contact with Concrete	Polyamidoamine Epoxy	1	4-6 MDFT	None		
	Steel Tank	Per 09871, Coating of Steel Water Storage Tank					
	Pumps	Touch up factory applied coatings, per Pump Specifications					

* Where in contact with potable water, coating shall be NSF-61 certified.

- B. Items Delivered with Factory Applied Primer:
 - 1. For items delivered with a factory applied primer and requiring painting under this Section, the factory applied primer may be used in lieu of field applied primer only under the following conditions:
 - a. The ENGINEER approves the use of the factory applied primer in lieu of field applied primer.
 - b. The factory applied primer is certified by the Coatings Manufacturer as compatible with the field applied finish coat.
 - c. The Coatings Manufacturer's recommended recoat time for the factory applied primer has not been exceeded.
 - 2. If all of the above conditions are not met, the Coatings Installer shall re-prepare all surfaces to be painted in strict accordance with Coatings Manufacturer's recommendations and primer applied, in accordance with this Section.
- C. Table Definitions:
 - 1. SF/Gal: Square foot of coverage per gallon of coating used.
 - 2. MDFT: mil dry film thickness
 - 3. mil: 1/1000 of an inch paint thickness
 - 4. Ferrous Pipe: Includes Ductile Iron, Cast Iron, Steel, and Galvanized Steel piping
 - 5. Steel Items: Includes steel and galvanized steel items such as structural steel, doors, window frames, overhead coiling doors, bollard posts, steel gates, steel fences, and all other steel and galvanized steel items.
 - 6. Non-Metallic Pipe: Polyvinyl Chloride, Chlorinated Polyvinyl Chloride, Fiberglass Reinforced Plastic, High Density Polyethylene
 - 7. Exposed: Located above grade, exposed to the atmosphere not submerged. Includes surfaces inside and outside of buildings.
 - 8. Submerged: In an area which normally is under water or other liquid or is intermittently under water or other liquid.
 - 9. Buried: Located below grade, surrounded by backfill.
- D. Surfaces Not Requiring Painting:
 - 1. Unless otherwise stated or shown below or in other sections, the following areas or items will not require painting or coating:
 - a. Concrete surfaces.
 - b. Reinforcing steel.

- c. Copper, bronze, brass, Monel, aluminum, chromium plate, and stainless-steel surfaces, except where:
 - 1) Required for electrical insulation between dissimilar metals.
 - 2) Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
 - 3) Color coding of equipment and piping is required.
- d. Existing piping, fittings and pipe supports.
- e. Pipe unions or portions of piping systems where painting would make disassembly difficult or impossible.
- f. Prefinished electrical, mechanical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, HVAC equipment enclosures, ductwork, acoustical tile, cabinets, louvers, and wall panels.
- g. Electrical conduits.
- h. Cathodic protection anodes.
- i. Insulated piping and insulated piping with jacket will require prime coat only.
- j. Fiberglass reinforced plastic (FRP) surfaces with an integral ultra-violet resistant colored gel coat do not require painting, provided the color is as selected.
- k. Glass, plexiglass or other transparent or translucent material intended to allow passage of light.
- I. Civil/site materials such as asphalt, gravel, rock, chain-link fence, and plantings.

3.4 RECOAT TIMES:

A. Coatings Installer shall observe all requirements of the Coatings Manufacturer regarding recoat times.

3.5 PAINT LOG

- A. Coatings Installer shall keep a paint log
 - 1. Specific details of the contents and format paint log shall be determined by the Coatings Installer and approved by the ENGINEER.
 - 2. At a minimum, paint log shall record, on a daily basis for any day when coating work is performed:
 - a. Weather conditions, including 3-day forecast
 - b. Which surfaces were prepared for coating
 - c. Approval of surface preparation by the Coatings Manufacturer representative
 - d. Which surfaces or systems were coated that day
 - e. Who the installer was (specific names of persons on crew)
 - f. Which coating type was used
 - g. Which coat was installed
 - h. What the application rate or MDFT was (as approved by ENGINEER)
 - 3. Paint log shall be kept on-site. Paint log shall be signed on a daily basis, for any day when coating work is performed, by the supervisor of the coatings installer field crew and by the ENGINEER.
 - 4. Any painted surface which was not recorded in the paint log shall be stripped, reprepared, and recoated at the ENGINEER's discretion.

3.6 WARRANTY INSPECTION

A. Warranty inspection shall be conducted during the eleventh month following completion of the Work. All defective Work shall be repaired by the CONTRACTOR in accordance

with this Specification and to the satisfaction of the ENGINEER and at the CONTRACTOR'S expense.

- B. Any location where paint has peeled, bubbled, or cracked and any location where rusting is evident shall be considered to be a failure of the system. The CONTRACTOR shall make repair at all points where failures are observed by removing the deteriorated paint, cleaning the surface, and recoating or repainting with the same system. If the area of failure exceeds 25 percent of the total coated or painted surface, the entire coating or paint system may be required to be removed and repainted in accordance with this specification as determined by the ENGINEER.
- C. All costs for CONTRACTOR'S inspection, Manufacturer's inspection and all costs for repair shall be borne by the CONTRACTOR.

++ END OF SECTION ++

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

<u> PART 1 - GENERAL</u>

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform the testing, adjusting and balancing of HVAC systems.

1.2 QUALITY ASSURANCE

- A. Quality Control procedures shall be in accordance with Section 01 45 00, Quality Control.
- B. Balancer's Qualifications:
 - 1. Submit biographical data on employee proposed to directly supervise the testing, adjusting and balancing Work.
 - Submit proof of certification by NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council), or SMACNA proof of registration in the State of Arizona and a record of at least five years of experience in the testing and balancing contracting industry, engaged in heating, ventilating and air conditioning (HVAC) Work.

1.3 SUBMITTALS

- A. Submittal shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Data Forms:
 - 1. Submit data forms on each item of testing equipment required. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.
 - 2. All field data pertaining to each item of equipment being tested must be tabulated and submitted on the standard forms of NEBB, AABC, or SMACNA.
 - 3. Testing agency shall sign and date each form in the space provided and proof of certification shall accompany the final report.
- C. Report Forms:
 - 1. Submit example copies of report forms for ENGINEER'S approval.
 - 2. Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.
 - 3. Reports shall be on the organizations approved forms imprinted with the company's name.
 - 4. Certified report outlining procedure used to balance the system and the types of measuring devices used.
- D. Test results shall be submitted on approved forms in a typed format.

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Provo City Provo City Water Reclamation Facility E. Submit certified copies of required test reports to the ENGINEER for approval.

1.4 JOB CONDITIONS

- A. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the testing, adjusting and balancing Work specified.
- B. Testing, adjusting and balancing shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

1.5 OPERATING INSTRUCTIONS

A. Reports shall be certified by CONTRACTOR verifying that the methods used and the results achieved are as specified.

1.6 CORRECTIVE ADJUSTMENTS

- A. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such Work shall be performed by CONTRACTOR, at no additional cost to the OWNER.
- B. Inspections:
 - 1. Fan Belt Deflection: No less than 1/4-inch or more than a 1/2-inch.
 - 2. Finned Coils: Fins shall be combed out with a fin comb for appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.

PART 2 - PRODUCTS

2.1 BALANCING INSTRUMENTATION

- A. Provide all necessary instrumentation, tools, ladders, etc. to complete all air balancing, tests and adjustments.
- B. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards stipulated by these organizations.
- C. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.
- D. Assume full responsibility for safe-keeping of all instrumentation during the course of the Work.

PART 3 - EXECUTION

3.1 GENERAL

A. Testing, adjusting, and balancing of air systems shall be performed in compliance with the standard procedure manual published by the testing, adjusting, and balancing

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organization affiliated with CONTRACTOR. Submit one copy of the standard procedure manual to the ENGINEER for record purposes only.

- B. Sole responsibility for the protection and safeguarding of the Work and providing every protection against accidents, injury, and damage to persons and property belongs to CONTRACTOR.
- C. Keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day.
- D. Full responsibility for removal and reinstallation of ceiling system and replacement of any component damaged belongs to CONTRACTOR.
- E. Install additional access panels, at no additional cost to the OWNER, as required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
- F. Air systems shall be tested, adjusted, and balanced with clean filters.

3.2 INSPECTION

- A. Pre-Startup Inspection:
 - 1. Verify proper equipment mounting and setting.
 - 2. Verify that control, interlock and power wiring is complete.
 - 3. Verify alignment of motors and drives.
 - 4. Verify proper piping connections and accessories.
 - 5. Verify that lubrication is completed.
- B. First Run Observations:
 - 1. Verify direction of rotation.
 - 2. Verify setting of safety controls.
 - 3. Monitor heat buildup in bearings.
 - 4. Check motor loads against manufacturer's nameplate data.
- C. Equipment Check:
 - 1. Verify proper overload heater sizes.
 - 2. Verify function of safety and operating controls.
 - 3. Verify proper operation of equipment.
 - 4. Report on inspection, observation and checking procedures.
- D. Fire Alarm Systems
 - 1. HVAC systems shall be interlocked to the fire alarm(s) system. When alarm is engaged, equipment fan(s) shall shut down.
 - a. Coordinate with fire alarm system supplier

3.3 AIR SYSTEMS

- A. Preliminary:
 - 1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.
- B. Central Systems:

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- 1. Test rpm for all equipment, including adjustment to each fan and air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
- 2. Adjust or change drive sheaves as required to adjust actual cfm to scheduled cfm.
- 3. Test and record motor voltages and running amperes, including motor manufacturer's nameplate data, and starter heater ratings for each unit as listed above.
- 4. Make Pitot tube traverse of main supply, exhaust and return ducts, determine cfm at all fans and units and adjust fans and units to within five percent of design requirements.
- 5. Test and record system suction and discharge static pressure.
- 6. Test and adjust system for design outside air, cfm.
- 7. Test and adjust system for design recirculated air, cfm.
- 8. Test and record heating apparatus outdoor entering air temperatures, dry bulb.
- 9. Test and record heating apparatus return air temperatures, dry bulb.
- 10. Test and record heating apparatus mixed air temperatures, dry bulb.
- 11. Test and record heating apparatus leaving air temperatures, dry bulb.
- 12. Test and record cooling apparatus outdoor entering air temperatures, dry bulb and wet bulb.
- 13. Test and record cooling apparatus return air temperatures, dry bulb and wet bulb.
- 14. Test and record cooling apparatus mixed air temperatures, dry bulb and wet bulb.
- 15. Test and record cooling apparatus leaving air temperatures, dry bulb and wet bulb.
- 16. Record all fan and air handling unit speeds.
- 17. Record air quantity delivered by each fan and air handling unit.
- C. Distribution:
 - 1. Adjust volume dampers, control dampers, splitter dampers, air extractors, etc. to proper design cfm in main ducts, branch ducts, and zones.
- D. Air Terminals:
 - 1. Identify each air terminal as to location and determine required flow reading.
 - 2. Test and adjust each air terminal to within tolerance of design requirements as listed below:
 - a. Diffusers and Supply Registers: 0 percent to +10 percent.
 - b. Return Registers: 0 percent to -10 percent.
 - c. Exhaust Registers: 0 percent to -10 percent.
 - 3. Test procedure on air terminals shall include recording comparison of required cfm and observed cfm, adjustment of terminal, and recording of final cfm.
 - 4. Adjust flow patterns from air terminal units to minimize drafts to extent design and equipment permits.
 - E. Verification:
 - 1. Prepare summation of readings of observed cfm for each system, compared with required cfm, and verify that duct losses are within specified allowable range.
 - 2. Verify design cfm at fans as described above.
 - 3. If the air systems are not properly balanced, rebalance and recheck all data in the presence of ENGINEER and as approved by the ENGINEER.

3.4 AUTOMATIC CONTROL SYSTEM

- A. In cooperation with the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.
- B. Verify all controls for proper calibration and operation and list those controls requiring adjustment by control system installer.

3.5 MANUFACTURER'S SERVICES

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 4 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system and instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment and controls conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

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SECTION 23 31 00

DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SERVICE CONDITIONS

A. Ductwork material of construction will be called out on the drawings.

1.2 QUALITY ASSURANCE

- A. Quality Control procedures shall be in accordance with Section 01 45 00, Quality Control.
- B. Manufacturer Qualifications:
 - 1. Engage a single firm, with undivided responsibility for performance and other requirements and components of the ductwork.
 - 2. Engage a firm which can show successful experience in the fabrication and erection of ductwork systems of scope and type similar to the required Work.
- C. Installer Qualifications:
 - 1. Engage a single installer regularly engaged in ductwork installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire ductwork system with undivided responsibility for performance and other requirements.

D. Requirements of Regulatory Agencies:

- 1. Building Codes: Comply with the:
 - a. Uniform Building Code, as supplemented by the authorities having jurisdiction.
 - b. Uniform Mechanical Code, as supplemented by the authorities having jurisdiction.
- 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections by authorities having jurisdiction.
- E. Reference Standards: Comply with applicable provisions and recommendations of the latest editions of the following, except as otherwise shown or specified. Specific provisions of this Contract shall supersede the Standards in case of conflict:
 - 1. Code of Federal Regulation (CFR):
 - a. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
 - American Conference of Governmental Industrial Hygienists (ACGIH):
 a. ACGIH Industrial Ventilation
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE Handbook Series Fundamentals: Duct Design
 - b. ASHRAE Handbook Series Equipment: Duct Construction
 - 4. ASTM International:

- a. ASTM A90 / A90M Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- b. ASTM A 167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- c. ASTM A653 / A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- 5. National Fire Protection Association (NFPA):
 - a. NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - b. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems
- 6. Sheet Metal and Air Conditioning Subcontractors National Association (SMACNA):
 - a. SMACNA HVAC Duct Construction Standards
 - b. SMACNA Round Industrial Duct Construction Standards
 - c. SMACNA Rectangular Duct Construction Standards
 - d. IAQ Guidelines for Occupied Buildings Under Construction.
- 7. Underwriters Laboratories Inc. (UL):
 - a. UL 181 Factory-Made Air Ducts and Air Connectors

1.3 SHOP DRAWINGS

- A. Shop Drawings: Submit for approval the following:
 - 1. 1/4-inch scale duct layouts
 - 2. Dimensions
 - 3. Details of construction
 - 4. Details of installation
 - 5. Manufacturer's literature, illustrations, specifications and engineering data
 - 6. Ceiling diffusers and registers, see Section 23 37 13. Provide schedule of air outlets indicating location and quantity.
 - 7. Fire Dampers:
 - a. Closing mechanisms
 - b. Fusible link operating temperature
 - c. Installation details
 - d. Access Doors (UL Listed)
 - 8. Access doors
 - 9. Flexible connections
 - 10. Duct sealants
 - 11. Deviations from Contract Documents
- B. Test Reports: Submit the following test reports for approval.
 - 1. UL Label, Fire Dampers.
 - 2. Damper leakage tests from an AMCA approved testing laboratory.

1.4 OPERATION AND MAINTENANCE MANUALS:

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with the requirements of Section 01 33 00, Submittal Procedures
- B. Submit complete manuals including copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation and spare parts information.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Product Delivery, Storage and Handling shall be in accordance with the requirements of Section 01 66 10, Product Storage, Handling, and Delivery.
- B. Store equipment and materials so as to keep free from moisture, damage, and deterioration.
- C. Manufacturer shall protect all flange faces and the more fragile appurtenances of the subassemblies, with padding between pieces in order to prevent one piece from impacting with another, and by crating or other means for shipment.
- D. Duct subassemblies shall be unloaded with care and stored in a location where they will be free from damage. Impact of a tool or other heavy object may result in a fracture of the inner lining and affect the service life of the duct or equipment.
- E. Large subassemblies shall be supported during unloading to prevent excessive deflection and overstressing.
- F. Ductwork shall be protected, by padding or bracing, from banding or ropes used in shipment. No chains are to be used to secure any ductwork during transportation.

1.6 GENERAL REQUIREMENTS

- A. The Drawings show general arrangement and extent of Work to be done, but the exact location and arrangement of all parts shall be determined as the Work progresses, to conform in the best possible manner with its surroundings. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions. Piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc. shall be located to clear such obstructions. Connections shown to the various units are intended as an indication only. The actual connections shall be made and to best suit each particular case, provide for expansion, circulation and minimize the amount of space required.
- B. Drawings do not show all offsets, fittings, accessories and details which may be required. CONTRACTOR shall field survey all conditions which may affect the installation of the Work and shall arrange the Work accordingly. Provide all required items to complete the systems to the extent required by the Contract Documents.
- C. If ductwork can be run to better advantage, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.

PART 2 - PRODUCTS

2.1 METALLIC RECTANGULAR DUCTWORK

- A. Type:
 - 1. Aluminum (Alloy 3003 H-14).
 - a. All accessories and hardware shall be aluminum, unless otherwise noted.

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- b. All fasteners shall be Type 304L stainless steel, unless otherwise noted.
- 2. Type 304L stainless steel.
 - a. All accessories, hardware, and fasteners for stainless ductwork shall be Type 304L stainless steel unless otherwise noted.
 - b. Provide Type 304L stainless steel where ductwork is specified to be welded.
- 3. Galvanized G90 steel.
 - a. All accessories, hardware, and fasteners for stainless ductwork shall be Type 304L stainless steel unless otherwise noted.
- B. Construction: Conform to the latest edition of SMACNA Standards.
 - 1. All sheet metal construction shall conform to a minimum pressure classification of 2-inches of water gauge (positive and negative pressure), unless otherwise shown or specified, and shall be in accordance with the construction details and installation details in the latest edition of the SMACNA HVAC Duct Construction Standards. This standard is hereinafter referred to as HVAC DS.
 - 2. Duct construction alternatives (duct gage in relation to reinforcement spacing) selected by the CONTRACTOR from HVAC DS tables shall be identified by duct system and shall be submitted in schedule form to the ENGINEER prior to beginning installation of ductwork. CONTRACTOR shall construct ductwork to meet the requirements of the HVAC DS tables in conjunction with the minimum thickness schedule below.
 - 3. Longitudinal seams shall be Pittsburgh type with permanently elastomeric sealant applied continuously within the seam.
 - 4. Type 304L stainless steel ductwork minimum thicknesses: Duct Dimension (maximum side): Thickness: Under 12 inches 0.028 in. (No. 24 B&S Gage) Between 12 and 30 0.034 in. (No. 22 B&S Gage) Between 31 and 36 0.040 in. (No. 20 B&S Gage) Between 37 and 48 0.052 in. (No. 18 B&S Gage) Above 48 0.064 in. (No. 16 B&S Gage) 5. Aluminum ductwork minimum thicknesses: Duct Dimension (maximum side): Thickness: Under 12 inches 0.040 in. (No. 18 B&S Gage) Between 12 and 30 0.050 in. (No. 16 B&S Gage) Between 31 and 54 0.064 in. (No. 14 B&S Gage) 0.071 in. (No. 13 B&S Gage) Between 55 and 84 0.090 in. (No. 11 B&S Gage) Above 84 6. Galvanized G90 steel ductwork minimum thickness: Duct Dimension (maximum side): Thickness: Under 12 inches 0.019 in. (No. 26 B&S Gage) Between 12 and 30 0.025 in. (No. 24 B&S Gage) Between 31 and 36 0.032 in. (No. 22 B&S Gage) Between 37 and 48 0.038 in. (No. 20 B&S Gage) Above 49 0.050 in. (No. 18 B&S Gage)
 - 7. Ductwork shall be connected by a mechanical joining system manufactured by Ductmate Industries, Inc., or equal except where otherwise noted. Manufacturers' installation instructions will be followed, except where otherwise noted.

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a. Rectangular Ductwork: SMACNA T-24 flange type connectors formed from the duct edge will NOT be allowed. All connectors shall meet or exceed the functional criteria outlined in SMACNA.

- 8. Stiffener angles shall be constructed of the same material as the duct or transverse connector.
- 9. Turning Vanes, Splitter Dampers, Transitions, Offsets, Branch Take-offs and Elbows:
 - a. Reference: SMACNA.
 - b. Construction: Same material as ductwork
 - c. Vanes: Double thickness
 - d. Branch Take-offs: 45 degrees, NO straight taps unless specifically shown
 - e. Elbows shall be the radius type with R'1.5, unless specifically shown otherwise.
 - f. Where space limitations prevent the use of a radius elbow provide a square throat elbow with turning vanes.
- C. Leakage: Not to exceed 5%.
- D. Flexible duct or duct constructed of fiberglass duct board shall not be permitted on the job, except where specifically shown on the Drawings.

2.2 METALLIC ROUND DUCTWORK

- A. Type:
 - 1. Aluminum (Alloy 3003 H-14).
 - a. All accessories and hardware shall be aluminum, unless otherwise noted.
 - b. All fasteners shall be Type 304L stainless steel, unless otherwise noted.
 - 2. Type 304L stainless steel.
 - a. All accessories, hardware, and fasteners for stainless ductwork shall be Type 304L stainless steel, unless otherwise noted.
 - b. Provide Type 304L stainless steel where ductwork is specified to be welded.
 - 3. Galvanized G90 steel.
 - a. All accessories, hardware, and fasteners for stainless ductwork shall be Type 304L stainless steel unless otherwise noted.
- B. General: Conform to the latest edition of SMACNA Standards.
 - 1. All sheet metal construction shall conform to a minimum pressure classification of 2-inches of water gauge (positive and negative pressure), unless otherwise shown or specified, and shall be in accordance with the construction details and installation details in the latest edition of the SMACNA HVAC Duct Construction Standards. This standard is hereinafter referred to as HVAC DS.
 - 2. Duct construction alternatives (duct gage in relation to reinforcement spacing) selected by CONTRACTOR from HVAC DS tables shall be identified by duct system and shall be submitted in schedule form to the ENGINEER prior to beginning installation of ductwork. CONTRACTOR shall construct ductwork to meet the requirements of the HVAC DS tables in conjunction with the mini-mum thickness schedule below.
 - 3. Ductwork shall be manufactured by United McGill Corporation series UNI-SEAL or equal.
 - 4. Ductwork fittings shall be manufactured by United McGill Corporation series LO-LOSS or equal.

24 Gage

- 5. Round, single wall, spiral lock seam ductwork.
- 6. Type 304L Stainless Steel Ductwork Minimum Thicknesses: <u>Duct Diameter:</u> Under 13 inches: 26 Gage

14 thru 19 inches:

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20 thru 24 inches:	22 Gage
25 thru 36 inches:	20 Gage
37 thru 48 inches:	18 Gage

7. Aluminum Ductwork Minimum Thicknesses:

	Incologia.
Duct Diameter:	Minimum Thickness:
Under 26 inches:	0.040 inches
27 thru 36 inches:	0.050 inches
37 thru 50 inches:	0.063 inches
Calvanized CON Steel Ductwork Minimum Thicknesses	

- Galvanized G90 Steel Ductwork Minimum Thicknesses: <u>Duct Diameter:</u> Under 8 inches: 9 thru 14 inches: 15 thru 26 inches: 26 Gage 26 Gage
- 9. Ductwork shall be provided in continuous unjoined lengths wherever possible, except when interrupted by fittings and dampers.
- 10. Fittings: Elbows shall be die-stamped with a bend radius of 1.5 times the elbow diameter. Converging flow fittings shall be constructed with a radiused entrance to all branch taps and with no excess material projecting from the body into the branch tap entrance. Conform to the following requirements:
 - a. All branch entrances shall be by means of factory fabricated fittings or factory fabricated duct tap assemblies.
 - b. Elbows up to 15 degrees shall be 3 pieces, 30 degrees 4 pieces, and 5 pieces between 31 to 90 degrees. Elbows shall be fabricated from continuously buttwelded gore sections. Gore sections shall be welded and finish ground to eliminate internal and external projections
 - c. Increasers and Reducers: ASME short flow nozzle shape, continuously buttwelded.
 - d. Tees: Conical short flow nozzle shape continuously butt-welded.
 - e. Laterals: Conical ASME short flow nozzle shape at 30 degrees to 45 degrees, continuously butt-welded.
 - f. Round Tap Fittings: 45 degrees conical taps, continuously butt-welded.
 - g. Join fittings using companion-angle Vanstone flange connection. Seal connection with specified sealant or gasket when a removable connection is required.
- 11. Connections: Ductwork and fittings shall be connected using flanged joints in accordance with the manufacturer's installation procedures and duct sealant recommendations.
- 12. Galvanized Round Duct Joints: Join by means of couplings with swaged bead in center and secured with sheet metal screws at each end of coupling. Make duct-to-fittings joints by either a tight slip fit of the fitting lapped inside the duct or by means of couplings with swaged bead in center, secured with sheet metal screws. Screw spacing: 6 inches unless otherwise shown on the Drawings. Seal joints and seams with specified internal sealant applied continuously around the coupling.
- C. Leakage: Not to exceed 5 percent.

2.3 SEAL CLASS:

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

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- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Outdoor, Supply-Air Ducts: Seal Class A.
 - 2. Outdoor, Exhaust Ducts: Seal Class C.
 - 3. Outdoor, Return-Air Ducts: Seal Class C.
 - 4. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-inch wg and Lower: Seal Class B.
 - 5. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 6. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-inch wg and Lower: Seal Class C.
 - 8. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 9. Conditioned Space, Return-Air Ducts: Seal Class C.
- C. Do not seal at fire dampers in a way that violates UL or code installation requirements

2.4 GALVANIZING REPAIRS

A. Repair galvanizing damaged by welding, scratches, etc., using Z.R.C., no known equal, cold galvanizing compound.

2.5 METALLIC DUCT ACCESSORIES

- A. Hangers:
 - 1. All ductwork shall be supported from trapeze type hangers. Hanger rods shall be minimum 3/8-inch for all ducts with half perimeter up to 72-inches, and 1/2- inch diameter for all ducts with half perimeter larger than 72-inches. A pair of rods shall be provided at each duct support point. Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72-inches and 6 feet for ducts with half perimeter larger than 72-inches.
 - 2. Provide structural steel supports as required to mount hangers from building.
 - 3. All hangers, rods, supports, bolts, nuts, washers, inserts, supports, and appurtenances located in corrosive areas shall be Type 316 stainless steel and those located in non-corrosive areas shall be galvanized steel.
 - 4. Hanger Construction and installation shall conform to SMACNA Standards, except as specified. No sheet metal duct hangers or straps will be allowed.
- B. Duct Wrap and Liner:
 - 1. 2-inch thick, 3-pound density. Minimum 0.70 NRC, minimum 0.24K at mean temperature of 75°F. NFPA-90A approved black coating on one side.
 - 2. U. L. Ratings:
 - a. Flame Spread Max: 25
 - b. Fuel Contribution: 50
 - c. Smoke Developed: 50
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Mansville Microlite
 - b. PPG Textrafine
 - c. Or equal.
- C. Duct Insulation
 - 1. Rigid Thermal Insulation:
 - a. Type: Rigid fiberglass board with vapor barrier facing.

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b. Density: Minimum six pound per cubic foot.

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- c. Facing: Foil-Scrim-Kraft (FSK).
- d. Maximum Thermal Conductivity: 0.22 Btu in/hr-ft²-degree F at 75 degrees F mean temperature.
- e. Water Vapor Transmission: Maximum 0.05 perm.
- f. Manufacturers:
 - 1) CertainTeed.
 - 2) Johns Manville.
 - 3) Owens Corning.
 - 4) Or equal.
- 2. Schedule:
 - a. Insulation Thicknesses:
 - 1) Insulation shall be minimum 2-inches thick with a minimum installed thermal resistance value of R-10.
- 3. Insulation Locations:
 - a. Where ductwork travels through an area not conditioned.
 - b. Exposed ductwork to the exterior environment.
 - c. Other areas as directed by ENGINEER.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished. Ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.
- B. Tape and seal all joints in accordance with SMACNA Standards.
- C. Fire/Smoke dampers shall be provided and installed where indicated on the Drawings and where required by U.L. and authorities having jurisdiction, and shall be approved by local building codes and in accordance with the requirements of the NFPA.
- D. Install all ductwork and accessories to provide a system free from buckling, warping, breathing or vibration.
- E. All ducts at expansion joints and flexible connections shall be suitably supported at each end within 12-inches of joint.
- F. Coordinate all air outlets for compatibility with ceiling system.
- G. Install duct liner in roof mounted supply, return and outside air ductwork. Provide adhesive pins or stick clips for mounting duct liner to inside walls of ductwork.

3.2 ADJUSTMENT

- A. Set volume control devices for approximate positions in preparation for final testing and balancing.
- B. Start fan system and check for excessive leaks and vibration and correct.

3.3 CLEANING

- A. Remove all loose materials and obstructions from interior of ducts.
- B. Remove debris and waste materials resulting from installation.

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SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section includes registers and grilles for the following:
 - 1. Supply diffusers
 - 2. Supply registers
 - 3. Return grilles

1.2 REFERENCE

- A. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 Factory-Made Air Ducts and Connectors.
- C. ARI-ADC Standard 880

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Details of construction.
 - 2. Details of installation.
 - 3. Manufacturer's literature, illustrations, specifications and engineering data.
 - 4. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - 5. Sound ratings
 - 6. Deviations from Contract Documents.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store equipment and materials so as to keep free from moisture, damage, and deterioration.

PART 2 - PRODUCTS

2.1 SUPPLY REGISTER (SR)

- A. The industrial supply register shall be double deflection type.
- B. Construction:
 - 1. The register shall be constructed with extruded aluminum frame and corners that are mitered and reinforced with aluminum chevrons by full penetration welds.
 - 2. The frame of the grille shall be constructed of 22 gage steel or roll formed aluminum with minimum 0.032'' thickness for sizes less than and equal to 24''x24'' and extruded aluminum with nominal thickness 0.040 0.050'' for sizes greater that 24''x24'' with countersunk screw holes.

23 37 13-1

- 3. This grille shall have individually adjustable blades on 3/4" centers with friction pivots constructed of 0.025" aluminum.
- 4. Dimensions as noted on drawings.
- C. Performance:
 - 1. The manufacturer shall provide published performance data for the register.
 - 2. Performance data shall include 2 7 octave band sound power levels.
 - 3. The register shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.
- D. Finish:
 - 1. The paint finish shall be #44 British White and be an anodic acrylic paint, baked at 315°F for 30 minutes. The paint thickness shall be 0.8 1.0 mils, gloss at 60° per ASTM D523.
- E. Manufacturer and Model
 - 1. Krueger, Model 5880
 - 2. Or approved equal.

2.2 RETURN GRILLE (RG)

- A. The return grille shall be egg crate type.
- B. Construction:
 - 1. Grille must have at least a 90% free area for the core style, $1/2'' \times 1/2'' \times 1''$.
 - 2. The frame of the grille must be constructed of extruded aluminum with a thickness of 0.04'' 0.05'' and countersunk screw holes.
 - 3. Frame border shall be a minimum of 1 1/4" around all sides of the grille with mitered corners that are mechanically staked for rigidity
 - 4. Dimensions as noted on drawings.
- C. Performance:
 - 1. The manufacturer shall provide published performance data for the diffuser.
 - 2. Performance data shall include 2 7 octave band sound power levels.
 - 3. The diffuser shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.
- D. Finish:
 - 1. The paint finish shall be #44 British White applied by an anodic electrocoating process.
- E. Manufacturer and Model:
 - 1. Krueger Model EGC15
 - 2. Or approved equal

2.3 OPPOSED BLADE DAMPER (OBD)

- A. The OBD shall provide airflow adjustment at the register, grille or diffuser.
- B. Construction:

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- 1. Damper shall be same material or compatible with ductwork and/or other equipment in contact.
- 2. Aluminum, steel or stainless-steel construction.
- 3. Round duct applications shall be radial type, gang operated
- 4. Sized as scheduled with associated equipment or accessory.

C. Performance:

- 1. Screw operated through face.
- 2. Pressure rated for use at or above ductwork.
- D. Finish:
 - 1. Mill finish
- E. Manufacturer and Model:
 - 1. Krueger
 - 2. Or approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and instructions and as shown on the Drawings and specified.
- B. Provide aluminum opposable blade dampers for balancing of HVAC systems.
- C. All equipment shall be fastened with stainless steel hardware.
- 3.2 ADJUSTMENT
 - A. Set equipment volume control devices in accordance with 23 05 93 Testing, Adjusting and Balancing of HVAC Systems.

3.3 CLEANING

- A. Remove all loose materials and obstructions from face of equipment.
- B. Remove debris and waste materials resulting from installation.

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SECTION 23 70 00

HEATING, VENTILATION, AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 SERVICE CONDITIONS

A. All units will be designed using the following outdoor design conditions:

Elevation, ft MSL	4,500
Summer	
Outdoor Dry-Bulb Temperature	98 degrees F
Outdoor Wet-Bulb Temperature	62 degrees F
Winter	
Outdoor Dry-Bulb Temperature	1 degree F

B. All equipment located outside shall be capable of continuous operation in environmental conditions installed. Provide applicable accessories and coatings for proper operation in environmental conditions.

1.2 SUBMITTALS:

- A. Submittals shall be in accordance with the requirements of Section 01 33 00, Submittal Procedures.
- B. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that include make, model, dimensions, weight of equipment, horsepower, and electrical schematics for products and control system components specified.
- C. Complete performance data that indicates full compliance with the Specifications.
- D. Recommended procedures for protection and handling of equipment and materials prior to installation.
- E. Manufacturer's standard finish color selection for cabinet finishes.
- F. Operation and Maintenance Manuals: Submit complete manuals including copies of all approved shop drawings, test reports, maintenance data and schedules, description of operation, and spare parts information
 - 1. List of recommended spare parts for equipment and materials specified.

1.3 QUALITY ASSURANCE

- A. Quality Control procedures shall be in accordance with Section 01 45 00, Quality Control.
- B. Reference Standards: Comply with applicable provisions and recommendations of the latest editions of the following, except as otherwise shown or specified. Specific provisions of this Contract shall supersede the Standards in case of conflict:
 1. Air Conditioning, Heating, and Pefrigeration Institute (AHPI)
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

- a. 310/380, Standard for Packaged Terminal Air-Conditioners and Heat Pumps
- 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - a. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
 - b. HVAC Applications Handbook
 - c. Fundamentals Handbook
 - d. HVAC System and Equipment Handbook
- 3. Air Movement and Control Association Inc. (AMCA)
- 4. National Fire Protection Association (NFPA)
- 5. Underwriters Laboratories (UL)
- 6. Occupational Safety and Health Administration (OSHA)

1.4 DELIVERY, HANDLING, AND STORAGE

A. Delivery, handling and storage shall be in accordance with all manufacturer requirements and the requirements of Section 01 66 10, Product Storage Handling and Delivery.

1.5 WARRANTY

- A. Furnish 2-year warranty for all equipment.
- B. Furnish a 5-years special warranty for refrigeration section compressor(s).

PART 2 - PRODUCTS

2.1 WALL MOUNTED EXHAUST FAN (EXF)

- A. General: Provide steel wall-mounted exhaust propeller fan with thermostat control and thermostat bypass switch for on/off only control.
- B. Performance:
 - 1. Continuous operating temperature from -10° F to 130° Fahrenheit
 - 2. Propeller shall be statically and dynamically balanced in accordance with AMCA Standard 204-05
 - 3. The propeller and fan inlet shall be aligned and shall have precise running tolerances for maximum performance and operating efficiency
 - 4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing, fan performance, the model number and individual unit serial number
- C. Propeller:
 - 1. Propeller shall be constructed of cast aluminum tapered airfoil blades and cast aluminum hubs
 - 2. Propeller shall be securely attached to motor shaft with a standard square key, set screw and tapered bushing

D. Motor:

- 1. Motor enclosure shall be Open type
- 2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable.

- 3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
- 4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
- 5. Motor shall be speed controllable with factory mounted equipment set for 2 speeds as noted on schedule.
- E. Damper:
 - 1. Aluminum gravity type balanced for minimal resistance to flow.
- F. Coating:
 - 1. Coating shall be provided to protect from environmental conditions.
- G. Accessories:
 - 1. OSHA Motor Side Guard
 - 2. Weather hood kit with bird screen, 45-degree angle, aluminum material, matching coating
- H. Controls:
 - 1. Provide thermostat controller compatible with exhaust fan, unless otherwise noted.
 - 2. Provide barometric pressure controller as noted in fan schedule.
 - 3. Provide adjustable speed controller for 2 speed fans as noted on schedule
 - 4. Provide Manual ON/OFF switch for continuous operation of fan as noted on schedule
- I. Manufacturer:
 - 1. Loren Cook
 - 2. Greenheck
 - 3. Or Approved Equal

2.2 MAKE-UP AIR UNIT (MAU)

- A. General:
 - 1. UL Listed
 - 2. Conforming to AHRI Standard 260, 430 and 1210.
- B. Unit with Integral Direct Gas-Fired heating indoor installation. Airflow arrangement shall be Outdoor Air only. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification. Concrete curb form and installation provided by others. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.
- C. Coordinate size and location of all building penetrations required for installation of each MAU and associated ducting, plumbing and electrical systems.
- D. Coordinate sequencing of construction of associated plumbing, HVAC and electrical supply.
- E. Spare Parts:
 - 1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- a. Filters: 2" thick MERV 13 disposable pleated filters for each unit. Requested spare filters should match unit selected filters
- b. 1 Set(s) of fan belts, 1 set as spare.
- F. Unit with Integral Heating shall be fully assembled at the factory and consist of an insulated metal cabinet, sensors, filter assembly for intake air, supply air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection
- G. Materials of Construction
 - 1. Materials: Formed, single wall metal cabinet, fabricated to permit access to internal components for maintenance.
 - 2. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory shall have polyester urethane paint on 18-gauge G60 galvaneal steel. Base rail is 12 gauge, galvanized (G90) steel.
 - 3. Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum14 gauge galvanized (G90) steel.
 - 4. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - a. Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - b. Thickness: 1 inch (25 mm)
 - c. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - d. Location and application: Floor of each unit shall be insulated with fiberglass insulation. Full interior coverage of entire cabinet to include walls and roof of unit shall be semi-rigid type and installed between inner and outer shells of all cabinet exterior components when double walls are specified.
 - 5. Access panels: Unit shall be equipped with removable/lift off access panels to provide easy access to all major components. Access panels shall be fabricated of 18-gauge galvanized G90 steel.
 - 6. Supply Air blower assembly options:
 - a. Forward curve blower: Blower assembly consists of an electric motor as specified by A/E and a belt driven, double width, and double inlet forward curve blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on minimum 1.125 inch thick neoprene vibration isolators
 - b. Direct-drive fan(s) Blower assembly shall consist of an electric motor as specified by A / E. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125inch thick neoprene vibration isolators. Blower motor(s) shall be capable of continuous speed modulation and controlled by a factory supplied VFD.
 - 7. Control center / connections: unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections
 - 8. Service receptacle: 120 VAC GFCI service outlet shall be factory-provided and installed by this contractor in a location designated by the A/E.
 - 9. Curb Assembly: Contractor shall provide and install appropriate insulation for the curb assembly.
- H. Direct Gas-Fired Burner:

- Unit shall be factory assembled, piped and wired. Direct gas-fired system will be 92% efficient while supplying a burner that is capable of providing 25:1 turndown. Unit will utilize a draw through design and incorporate adjustable burner baffles plates for filed adjustments. Unit will have a direct spark ignition system.
- 2. Burner construction shall consist of a cast aluminum burner manifold and 400 series stainless steel mixing plates. No air from the inside space shall be allowed to pass across the burner at any time. Flame sensing shall be provided. Burner control shall have a digital coded fault indicator capable of storing the last five faults.
- 3. Shall be equipped for operation on natural gas with a maximum rated inlet gas pressure of 1/2 psi. An External Gas pressure regulator shall be provided by the factory.
- 4. Burner control options to include the following discharge temperature External signal for burner modulation with integral discharge temperature limits using an external 4 20 mA signal.
- I. Unit shall include the following safety controls:
 - 1. Manual Reset, High Limit Switch: Dual safety shutoff valves shall be that do not exceed 120 VAC control signals.
 - 2. High and low Gas Pressure Switch(s):
 - 3. Visual indication: Clear visual signal demonstrating the position of the main gas safety shutoff valves.
 - 4. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified by the A/E.
- J. Blower, Supply Air: Belt drive motor and blower shall be assembled onto a minimum 14 gauge galvanized steel platform and must have neoprene vibration isolation devices, minimum of 1 1/8 inches thick.
 - 1. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
 - 2. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
 - 3. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
 - 4. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating."
 - 5. Blower motors greater than ¾ horsepower shall be "NEMA Premium™" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Electrical Divisions, matched with fan load.
 - 6. Motors shall be 60 cycles, 3 phase 460 volt
- K. Unit Controls
 - 1. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied thermostat.

- 2. Provide necessary components for HVAC system to be controlled via facility SCADA system. Contractor to coordinate between manufacturer vendor and facility for a fully functional system.
- L. Sensors to be provided with the unit
 - 1. Room / Space Temperature Sensors
 - 2. Heating Inlet Air Sensor
 - 3. Dirty Filter Sensor
 - 4. 120V/24V Smoke Detector
- M. Filters: Unit shall have 2" thick MERV 13 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.
- N. Motor:
 - 1. The motor shall be mounted integral to the isolated fan assembly and furnished by the unit manufacturer. The motor is mounted inside the unit casing on an adjustable base to permit adjustment of drive belt tension.
 - 2. The motor shall meet or exceed all NEMA Standards Publication MG 1 requirements and comply with NEMA Premium efficiency levels when applicable except for fractional horsepower motors which are not covered by the NEMA classification.
 - 3. The motor shall be T-frame, squirrel cage with size, type, and electrical characteristics as shown on the equipment schedule.
 - 4. Direct-drive fan and motor assemblies shall be internally isolated from the unit casing with 2-inch deflection spring isolators.
 - 5. The isolation system shall be designed to resist loads produced by external forces, such as earthquakes, and conform to the current IBC seismic requirements.
- O. Variable Frequency Drive (VFD)
 - 1. Design VFD frequency is less than line frequency. Use caution during startup to ensure the VFD will not operate at the line frequency or ensure that the air delivery system can handle being over-pressurized.
 - 2. Starter/VFD shall be mounted externally in a NEMA Type 1 enclosure on the supply fan section. An external disconnect shall be mounted through-the-door to the starter/VFD to disconnect full power from starter/VFD.
 - 3. A combination Variable Frequency Drive (VFD) / disconnect shall be provided when variable air volume control is required for fan operation. Whether for single fan, dual fan, or fan array applications, a single VFD shall be provided to ensure proper operation and to optimize operating life. Each VFD / disconnect shall be properly sized, factory mounted in a full metal enclosure, wired to the fan motor(s), and commissioned to facilitate temporary heating, cooling, ventilation, and/or timely completion of the project. VFD / disconnects shall include a circuit breaker disconnect with a through-the-door interlocking handle and shall be lockable. The VFD package shall also include:
 - a. Electronic manual speed control
 - b. Hand-Off-Auto (H-O-A) selector switch
 - c. Inlet fuses to provide maximum protection against inlet short circuit
 - d. Current limited stall prevention
 - e. Auto restart after momentary power loss
 - f. Speed search for starting into rotating motor
 - g. Anti-windmill w/DC injection before start
 - h. Phase-to-phase short circuit protection
 - i. Ground fault protection

- j. Manual motor protection MMP
- 4. Units with factory-mounted controls shall include power wiring from the VFD panel to the control system transformers, binary output on/off wiring, analog output-speed-signal wiring, and all interfacing wiring between the VFD and the direct digital controller.
- 5. The VFD shall be UL508C listed and CSA certified and conform to applicable NEMA, ICS, NFPA, & IEC standards
- P. Controls:
 - 1. The heater shall be factory-wired to accommodate controller. The controller shall be able to receive a 0-10VDC signal from a thermostat providing full modulating control of the first increment of heat.
 - 2. The staged increments are turned on and off by the step controller. As each stage is required to fulfill the demand for heat, the internal controller is used as fully modulating between stages.
 - Thermostat shall be provided by the equipment supplier and shall be fully compatible with unit. Provide 7-day programmable type with full back-lit display.
 a. Make Up Air Units shall be controlled by thermostat
 - 4. Provide an air flow switch in the fan duct to confirm minimum flow. Contacts shall be rated 120VAC, 10A, Form C.
- Q. Manufacturer:
 - 1. Greenheck
 - 2. Trane
 - 3. Or Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment and systems in accordance with manufacturers' instructions.
- B. Make Up Air Units (MAU) and HVAC systems shall be interlocked to the fire alarm(s) system. When alarm is engaged, exhaust fans shall shut down.
 1. Coordinate with fire alarm system supplier.
- C. Provide return air flow system for MAU unit as shown on drawings
- D. Louvers:
 - 1. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
 - 2. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
 - 3. The supporting structure shall be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads
- E. Provide Testing and Balancing Reports of all HVAC systems, see Section 23 05 93, Testing, Adjusting and Balancing of HVAC Systems.
- F. Exhaust Fans:

23 70 00-7

Provo City Provo City Water Reclamation Facility 1. Provide two speed controller with barometric sensors where specified. First set speed to run at operator set time interval before second speed is activated. Speeds shall be adjustable for exhaust fan airflow range.

++ END OF SECTION ++

SECTION 26 00 00

GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope of Work:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to complete the electrical Work, including power distribution; grounding; lighting; miscellaneous power; building special systems such as security, closed circuit television, fire alarm, and lightning protection; controls; instrumentation; supervisory control and data acquisition, equipment provided under other specification sections; etc.
 - Provide mobilization, project coordination, demolition, and maintenance of operation services as required for the work in accordance with the specifications and the drawings.
 - 3. Equipment shall be rated and labeled by the manufacturer for the environmental conditions in which it is installed including the power disconnects, control stations, and wiring systems.
 - 4. Provide a preliminary short circuit and coordination analysis prior to the initial submittal of the electrical distribution equipment submittal to confirm the equipment being provided new and the existing equipment are appropriately rated for the short circuit duty available and to ensure that the protective devices being provided properly coordinate among themselves and with the existing installed equipment.
 - 5. Provide a final short circuit, protective devices coordination and arc flash analysis to be used for setting the protective devices and for providing the appropriate safety arc flash labeling on all equipment, existing and new after all submittals are approved. In addition, the final analysis report will be used by the OWNER as a benchmark for setting and testing protective devices in the future.
 - 6. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions.
 - 7. Provide conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Provide disconnect switches and lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions.
 - 8. Provide complete network cables and specialty cable systems. Install the network cables and other specialty cable systems furnished under other Divisions in accordance with the system manufacturers' installation instructions. Coordinate the raceway layout, prior to rough-in, with the computer system supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways. Maintain an 8-foot (minimum) separation between raceways with no single point of failure where practical and reasonable. Practical and reasonable shall be defined jointly by the Electrical Contractor, Prime Contractor, and Electrical Engineer.
 - 9. Provide a complete Fiber Optic Network System. Install the Fiber Optic Cables and other specialty cable systems furnished under other specification divisions in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the OWNER IT staff, fire alarm and

computer equipment system suppliers, and the cable manufacturers to ensure raceway compatibility with the systems and materials being furnished.

- 10. Installation of variable frequency drives furnished under other Divisions, including conduit, wiring and terminations, and associated equipment such as reactors, harmonic filters, transformers and power factor correction capacitors.
- 11. Provide power wiring for all heating, ventilating, and air conditioning equipment furnished under other related Divisions. Provide 120 V wiring for unit heater motors and thermostats and exhaust fan/light combination controls where required. Refer to HVAC Drawings for the locations of 120 V unit heater thermostats and provide a 3/4-inch C, 2 No. 12 and 1 No. 12 GRD between each heater and its respective control thermostat.
- 12. Provide precast manholes, handholes and light pole bases with appropriately trafficrated frames and covers.
- 13. Provide all necessary electrical work and materials necessary to make laboratory equipment operative (e.g., still, water-baths, fume hood, etc.).
- 14. Provide modifications to existing control systems as required to provide the control functions or inputs as shown on the Drawings. Verify all existing wiring and connections and provide installation of new auxiliary motor starter contacts, relays, switches, etc. Trace the circuits in the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a complete marked-up set of Record Drawings, with point-to-point terminal numbers, to the OWNER after the work is complete.
- 15. Coordinate with the Telecommunications Service Provider to provide High Speed Internet service from the service provider.
- 16. Perform testing of the electrical equipment in accordance with the requirements of the other Division 26 specifications. If the testing results are not within acceptable limits repair or replace all defective work and equipment at no additional cost to the OWNER. Make adjustments to the systems furnished under Division 26, Electrical in accordance with the equipment manufacturers requirements/recommendations.
- 17. Set the electrical protective devices in accordance with NETA standards and in accordance with the protective coordination study.
- B. Demolition
 - 1. Provide electrical demolition work associated with the removal of equipment from the existing facilities. The work shall include disconnecting and removing electrical disconnect switches, electrical wiring and conduit to equipment. Make equipment scheduled for removal free of electrical shock hazard.
 - 2. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint. Where a piece of equipment is to be removed all associated ancillary components (e.g., solenoid valves, pressure switches, etc.) and associated wiring and conduit shall also be removed.
 - 3. Equipment scheduled to be turned over to the OWNER shall be carefully disconnected, removed and delivered to the OWNER at a location within the existing site. Provide labor, hoisting, and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site. The following equipment shall be turned over to the OWNER:
 - a. Control panels
 - b. Switchgear
 - c. Switchboards

- d. Panelboards
- e. Transformers
- 4. Provide electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment. Make equipment scheduled for relocation free of electrical shock hazard in accordance with OSHA and local plant electrical safety requirements.
- 5. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned conduit above accessible ceiling finishes. Remove unused wiring back to source (or nearest point of usage).
- 6. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned or being removed. Provide blank covers for abandoned outlets which are not removed.
- 7. Disconnect and remove abandoned panelboards, disconnect switches, control stations, distribution equipment, etc.
- 8. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers and other accessories.
- 9. Repair adjacent construction and finishes damaged during demolition and extension work.
- 10. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated, and the system restored to normal operation.
- 11. Coordinate electrical power outages to the electrical systems and equipment with the OWNER. Where duration of proposed outage cannot be allowed by the OWNER (4 hour duration maximum), phase the retrofit work to allow the system or equipment to be re-connected to the electrical power system within the time frame allowed by the OWNER or provide temporary power connections as required to maintain service to the systems or equipment. The temporary power can be from a generator or another part of the facility not affected by the outage provided there is sufficient spare capacity.
- 12. Continuous service is required on all circuits and outlets affected by these changes, except where the OWNER will permit an outage for a specific time. Obtain OWNER's consent before removing any circuit from continuous service.
- 13. The electrical and process equipment to be removed or relocated under this contract has been identified on the Drawings. The removal and or relocation of existing conduit, wire and equipment have not been detailed on the Drawings. Survey the affected equipment and building areas before submitting bid proposal.
- 14. Trace out existing wiring that is to be relocated or removed and perform the relocation or removal work as required for a complete operating and safe system.
- 15. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.
- 16. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc., furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational.
- 17. Disposition of removed materials and equipment
 - a. It is intended that material and equipment indicated to be removed and disposed of by the CONTRACTOR shall, upon removal, become the CONTRACTOR's property and shall be disposed of off the site by the CONTRACTOR, unless otherwise directed by the OWNER. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the OWNER.

- b. PCBs, mercury and PCB/mercury contaminated equipment shall be removed, packaged, shipped and disposed of in accordance with all State and Federal regulations. Obtain the services of a firm licensed and regularly engaged in the removal of PCBs and PCB contaminated equipment. The firm shall be licensed in the State or States in which the contaminated material is handled, shipped and disposed. Pay all fees associated with the removal of the contaminated material and equipment and provide documentation showing acceptable disposal.
- C. Coordination:
 - 1. Coordinate the electrical service requirements with Provo Power Utility Company and provide the electrical service from the power company at the locations indicated.
 - 2. Review installation procedures, drawings and schedules under other Sections and coordinate with other trades the installation of electrical items that must be installed with or within formwork, walls, partitions, ceilings and panels.
 - 3. Coordinate with other contractors and provide the installation of all conduits, inserts, and other items to be embedded in concrete, or built into walls, partitions, ceilings, or panels constructed by other contractors. Provide detailed sketches of the location of conduits and other built-in items prior to rough-in. Install conduits and other built-in items in such a manner and within such time periods as will not unnecessarily delay the work of other contractors.
 - 4. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work that can reasonably be seen. Reasonable shall be defined jointly by the Electrical Contractor, Prime Contractor, and Electrical Engineer.
 - 5. Review the electrical underground system and the civil yard piping. Install the electrical underground system in a manner that avoids conflicts with manholes, catch basins, etc. provided under other Divisions of the specifications.
 - 6. Provide rubber floor mats for all electrical equipment, including switchgear, switchboards, and motor control centers.
 - Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished under Division 26, Electrical. The work shall be in accordance with Divisions 03, Concrete, and Division 31, Earthwork.
- D. Contract Documents:
 - 1. Interpretation of Drawings:
 - a. Dimensions shown on the Drawings that are related to equipment are based on the equipment of one manufacturer. Confirm the dimensions of the equipment furnished to the space allocated for that equipment.
 - b. The Drawings show the principal elements of the electrical Work. They are not intended as detailed working drawings for the electrical Work, but as a complement to the Specifications to clarify the principal features of the electrical systems.
 - c. It is the intent of the Drawings and Specifications that all equipment and devices, furnished and installed under this Contract, be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and

interconnections are specifically mentioned in the Specifications or shown on the Drawings.

- d. Conduit and wiring is indicated schematically on the drawings to show the desired functionality. Refer to the One-Line diagrams, Control Block Diagrams, Panelboard schedules, Schematic Diagrams, Loop Wiring diagrams, Network Diagrams, and Process and Instrumentation Drawings for wiring requirements.
- e. Wiring details are not shown on the plan drawings. CONTRACTOR to determine the optimum field routing and provide all fittings and accessories necessary for a complete system.
- f. Schematic Diagrams:
 - 1) Schematic diagrams are provided for CONTRACTOR'S guidance in fulfilling the operational intent of the Contract Documents.
 - 2) Responsibility belongs to CONTRACTOR to meet all safety and electrical codes, and to provide all equipment, appurtenances and specialty items required to provide for complete and operable systems. Devices intended for safety interlocks to protect personnel shall be UL safety rated. Devices intended for safety interlocks to protect equipment shall be fail-safe.
 - 3) Review of control schemes submitted by CONTRACTOR does not relieve CONTRACTOR of his contractual responsibility to provide complete and successfully operating systems.
- g. Underground duct bank raceways may be a minimum of 2-inch regardless of the conduit sizes indicated on the wiring drawings.
- h. It is the intent of the Contract Documents that similar products are provided by the same manufacturer for uniformity on the Project.
- 2. Priority of the contract documents
 - a. If, during the performance of the work, the CONTRACTOR finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.
 - b. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the ENGINEER and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.
 - c. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over shop drawings.
 - d. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, the higher performance requirement shall be binding on the CONTRACTOR, unless otherwise directed by the ENGINEER.
 - e. In accordance with the intent of the Contract Documents, the CONTRACTOR accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the CONTRACTOR's responsibility to comply with all Laws and Regulations at all times

- E. Temporary Power and Lighting:
 - 1. Coordinate temporary power with Provo Power Utility Company and OWNER. If utilizing existing facility power, upon approval, provide updated panel schedules and/or load summaries to the ENGINEER and OWNER identifying the recommended power sources and circuits for temporary services. ENGINEER and OWNER must provide approval prior to connecting to the services.
- F. Power Utility Service:
 - 1. The power company serving this project is Provo Power. Service will be obtained at 12,470 V, 3 Ph, 4 Wire, 60 Hz from a service riser furnished and installed by Provo Power.
 - 2. The power company will be responsible for the following work:
 - a. Furnishing and installing the primary overhead conductors and pole line.
 - b. Furnishing and installing the first riser pole on the property, primary cutouts, lightning arresters and grounding.
 - c. Furnishing and installing primary cables.
 - d. Furnishing and installing the transformer grounding.
 - e. Furnishing and installing transformer.
 - f. Termination of underground primary cables at riser pole.
 - g. Termination of underground primary cables at the transformer.
 - h. Furnishing metering current transformers (C.T.'s), meter and meter wiring.
 - i. Furnishing and installing secondary conduits and cables.
 - j. Furnishing meter base and enclosure.
 - 3. The CONTRACTOR shall be responsible for the following work:
 - a. Obtain an estimate from the power company for the work described above and include the cost of the power company work in the Bid Price.
 - b. Make all arrangements with the power company for obtaining electrical service, including all utility design services, construction, inspections, and fees; pay all power company charges; and furnish all labor and material required for the electrical service.
 - c. Furnishing and installing the primary conduits.
 - d. Furnishing and installing the transformer pad.
 - e. Furnishing secondary conduits and cables.
 - f. Furnishing and installing a power company approved metering current transformer enclosure.
 - g. Furnishing and installing an empty conduit with pull-tape from the metering C.T. enclosure to the meter enclosure. Conduit size and type shall be approved by the power company.
 - 4. Submit shop drawings for the following items to the power company for approval:
 - a. Service Entrance Section.
 - b. Manholes and duct bank plans.
 - c. Concrete equipment pads for utility equipment.
 - d. Meter base.
 - e. Primary conduit.
 - f. Metering instrument and installation.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Permits: Obtain all permits and pay fees required to commence Work and, upon completion of the Work, obtain and deliver to the ENGINEER a Certificate of Inspection and Approval from the authority having jurisdiction.

- 2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
- 3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
- 4. Utilities:
 - a. Provo Power Company: Work in connection with the electric service and utility metering shall be done in strict conformance with the requirements of Provo Power Company.
 - b. Telephone Company: Work in connection with the telephone lines for the telephone service shall be done in strict conformance with the requirements of the Telephone Company. Telephone system within the Plant is a private system and shall be coordinated with the City of Provo, Information Technology Department.
 - c. City of Provo, Information Technology Department.
- B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:
 - 1. National Electrical Manufacturers Association (NEMA).
 - 2. The American National Standards Institute (ANSI).
 - 3. The Institute of Electrical and Electronic Engineers (IEEE).
 - 4. Insulated Cable Engineers Association (ICEA).
 - 5. National Electrical Code (NEC) current adoption.
 - 6. National Electrical Safety Code (NESC).
 - 7. American Society for Testing and Materials International (ASTM).
 - 8. The Instrumentation, Systems and Automation Society (ISA).
 - 9. National Fire Protection Agency (NFPA).
 - 10. Underwriter's Laboratories, Inc. (UL).
 - 11. Occupational Safety and Health Administration (OSHA).
 - 12. Factory Mutual (FM)
 - 13. International Electrical Testing Association (NETA)
 - 14. State of Utah Building Code
 - 15. International Building Code (IBC)
 - 16. City of Provo Building Code
 - 17. International Fire Code (IFC)
 - 18. International Energy Conservation Code (IECC)
 - 19. The Building Officials and Code Administrators National Building Code (BOCA)
 - 20. ASTM International
 - 21. Institute of Electrical and Electronics Engineers (IEEE)
 - 22. Joint Industrial Council (JIC)
- C. Warranty: Warrant all equipment furnished under Division 26, Electrical, in accordance with Division 01, General Requirements and individual Division 26, Electrical equipment sections. Minimum warranty period shall be one year from date of substantial completion for the project, or manufacture's standard warranty, whichever is longer.
- D. Wiring Coordinator:

- 1. Retain the services of a Wiring Coordinator who shall prepare complete point-to-point interconnection wiring termination sheets. The sheets shall identify all external interconnecting wiring associated with all new and modified existing equipment.
 - a. Qualifications: Coordinator shall have experience in the development of the point-to-point interconnection wiring termination sheets and shall have served in a similar role on a project of similar size and complexity.
 - 1) Present qualifications and approach for the project at Pre-Construction Conference.
 - 2) Prepare the items listed below for presentation at the Pre-submittal Meeting. Submit to ENGINEER three weeks prior to date of meeting.
 - a) List of projects where the Wiring Coordinator developed point-to-point wiring termination sheets.
 - b) Samples of diagrams that were developed for the listed projects.
 - c) Example wiring diagram proposed for the Work with a preliminary list of drawings to be produced.
 - d) Plan of how information will be obtained and documented.
 - b. Responsibilities:
 - 1) Develop point-to-point interconnection wiring termination sheets for performance of the Work and to document terminations.
 - 2) Use information obtained from approved Shop Drawings, Record Drawings and field inspections as required to complete the sheets.
 - 3) Attend Pre-submittal Meeting and periodic process control system coordination and progress meetings.
 - 4) Conduct point-to-point wiring checks to determine wires and terminations are per the point-to-point interconnection wiring termination sheets. CONTRACTOR to sign-off on the sheets to document the checks were performed. After confirmation by the CONTRACTOR, submit the signed sheets to the OWNER/ENGINEER.
 - c. Point-to-Point Interconnection Wiring Termination Sheets: Include the following:
 - 1) External wiring for each piece of equipment, panel, instrument and other devices and conduit wiring to control stations, lighting panels and motor controllers.
 - 2) Numbered terminal block identification for each wire termination.
 - 3) Identification of the assigned wire numbers for all interconnections.
 - 4) Identification of all conduit wiring by the conduit tag in which the wire is installed.
 - 5) Terminal and pull boxes through which wiring is routed.
 - 6) Identification of all equipment and the Shop Drawing transmittal numbers for equipment from which the wiring requirements and termination information was obtained.

1.3 SUBMITTALS

- A. Refer to other Division 01, General Requirements, and Division 26, Electrical, specification sections for submittal requirements.
- B. Shop Drawings
 - 1. Shop Drawings shall include the following information to the extent applicable to the particular item:
 - a. Manufacturer's name and product designation or catalog number, including environmental rating such as "Rated for Outdoor Use" or "Rated for Hazardous Location".

- b. Electrical ratings.
- c. Conformance to applicable standards or specifications.
- d. Dimensioned plan, section, elevations and panel layouts showing means for mounting, conduit connection, and grounding.
- e. Materials and finish specification, including paints.
- f. Clearly identify all equipment and accessories proposed to be provided, including cross references to tag names as shown on the drawings.
- g. List of components including manufacturer's names and catalog numbers.
- h. Internal wiring diagram and drawings indicating all connections to components.
- i. External wiring diagram showing numbered terminals and all external connections and wire requirements.
- 2. Electrical distribution equipment will not be approved until a preliminary power system analysis is complete, including available fault current study, coordination study, and arc-flash study.
- 3. Submit reports and test results in accordance with other Division 26, Electrical, sections.
- 4. For all seismic design systems submit a P.E. certification Form prepared, stamped and signed by a professional engineer, registered in the State of Utah, verifying that the design and details meet the loading requirements and are in accordance with all applicable codes.
- 5. Check shop drawings for accuracy and completeness prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to this Section and the Drawings. List all exceptions to the specifications and the Drawings. Include the complete associated specification section with each paragraph marked INCORPORATED or REJECTED in the submittal documents. Shop drawings not so checked and noted shall be returned marked NOT APPROVED.
- 6. The ENGINEER's review shall be for conformance with the design concept of the project and compliance with the Drawings. Errors and omissions on approved shop drawings shall not relieve the CONTRACTOR from the responsibility of providing materials and workmanship required by this Section and the Drawings.
- 7. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered, or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."
- C. Operation and Maintenance Data
 - 1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Division 01, General Requirements. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists including replacement part numbers.
 - 2. Manuals shall include the following as a minimum:
 - a. A comprehensive, linked, table of contents.
 - b. Individually tabbed sections.
 - c. Name, address, and contact information for supplier and local support office.
 - d. A complete "As-Built" set of approved shop drawings.
 - e. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

- f. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
- g. System schematic drawings "As-Built," illustrating all components, piping and electric connections of the systems supplied under this Section.
- h. Detailed service, maintenance and operation instructions for each item supplied.
- i. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
- j. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
- k. Complete parts list with stock numbers, including spare parts.

1.4 PROJECT CLOSEOUT

- A. Record Drawings shall accurately show the installed condition of the following items:
 - 1. One line wiring diagram of the distribution system.
 - 2. Accurate and detailed in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.
 - 3. Underground raceway and duct bank routing and manhole and handhole locations with coordinates.
 - 4. Layouts of the power and lighting arrangements and the grounding system.
 - 5. Panel Schedule(s).
 - 6. Lighting Fixture Schedule(s).
 - 7. Grounding system wiring and components.
 - 8. Control schematic diagrams, with terminal numbers and all control devices identified, for all equipment.
 - 9. Point-to-Point Interconnection wiring diagrams with all terminals identified and all equipment, wire, and conduit tags indicated.
 - 10. Provide wire and conduit schedules indicating identification tags; termination points; wire/cable types, quantity, sizes; and terminal equipment tags.
 - 11. The Record Drawings shall reflect final equipment and field installation information.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.

1.6 JOB CONDITIONS

- A. Existing Conditions:
 - 1. Examine the site and existing facilities in order to compare them with the Contract Documents with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.
 - 2. Perform the Work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the plant.
 - 3. The operation of existing facilities shall be maintained throughout construction. Any interruption of operation shall be approved by and coordinated with the owner.
 - 4. Environmental conditions at the site are as follows:
 - a. Ambient air temperature: -23 to 38 degrees C (-10 to 100 degrees F)
 - b. Elevation: 4,550 feet (MSL).
 - c. Humidity: 80%

- B. Limitations:
 - 1. Work shall be carried out with a minimum amount of disruption to the operation of the existing plant and with prior approval of OWNER. Submit for approval by OWNER, a detailed written procedure for work which affects operation of the existing plant, a detailed procedure for modifying any existing electrical equipment, including appropriate Personal Protective Equipment (PPE) required if equipment must remain energized while conducting work, anticipated time required to complete the Work, and the required shutdown time, if any.
 - 2. Work requiring interruption to the operation of existing facilities shall be approved a minimum of two weeks in advance. Any interruption lasting longer than permitted by the owner for a given process will require an alternate contingency to maintain operation, such as portable standby generators completely at the cost to the CONTRACTOR including procurement operation, fuel, and maintenance.
 - 3. Where the Work of CONTRACTOR ties in with existing installations, take prior precautions and safeguards in connecting the Work with the existing operating circuits so as to prevent any interruption to the existing operating circuits. The tying in of Work, installed under this Contract, with the existing circuits shall be performed only in the presence of OWNER. Advance notice will be required before any equipment is removed from service. Notify OWNER, in writing, of his intention to do such work, providing full details.
- C. Structural Design Requirements:
 - 1. Provide structural design of electrical equipment, systems, and components, anchorage, and supports, including manufacturer's certifications, in accordance with General Product Requirements under Division 01, including seismic design.
 - 2. Design, furnish, and install complete anchorage systems in accordance with applicable codes for all electrical equipment specified in the appropriate sections in Division 26, Electrical. All hangers, supports, and appurtenances shall conform to the latest applicable requirements of the Local/State Building Code except as supplemented or modified by the requirements of this section. Support arrangements shall be coordinated to eliminate interference with similar support systems to be installed by HVAC, Plumbing and for Process Pipe supports.
- D. Demolition:
 - 1. The demolition of electrical power distribution equipment, instrumentation/ control equipment, conduit, wire and appurtenances shall be in accordance with the specifications. All salvageable equipment shall be turned over to the OWNER and stored on site per OWNER requirements. All refuge must be hauled away and disposed of at CONTRACTOR's expense.

1.7 ENVIRONMENTAL RATINGS

- A. Area Classifications:
 - 1. Materials and equipment shall conform to the area classification(s) shown on the Drawings, specified, and required.
 - 2. Materials identified below are the minimum required. The drawings may include additional requirements.
 - 3. Corrosive Locations: The following areas shall be considered corrosive locations:
 - a. Chemical storage and pumping areas.
 - b. Indoor process areas.
 - c. Outdoor areas.
 - 4. Hazardous Locations:

- a. Hazardous areas shall be as shown on the Drawings.
- b. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503.
- c. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.
- d. Materials, equipment and incidentals in areas identified as hazardous locations shall meet NEC requirements for the Class and Division designated.
- e. Devices that are not labeled for use in the hazardous area in which they are installed shall be wired from intrinsic safety barrier relays installed in accordance with NEC and UL requirements.
- B. Enclosures, Cabinets, Panels, and Boxes:
 - 1. All indoor DRY areas NEMA 12 gasketed.
 - 2. All indoor WET areas NEMA 4X 316 Stainless Steel.
 - 3. All indoor PROCESS areas NEMA 4X 316 Stainless Steel.
 - 4. All CORROSIVE areas NEMA 4X 316 Stainless Steel.
 - 5. All indoor CORROSIVE protected chemical storage and handling areas NEMA 4X nonmetallic (polycarbonate only).
 - 6. All OUTDOOR areas: NEMA 4X 316 Stainless Steel.
 - 7. All FINISHED office areas NEMA 1.
 - 8. HAZARDOUS classified areas: Listed and labeled suitable for the environment in which it is installed.
 - 9. Outdoor enclosures with electronics and temperature sensitive instruments, shall be provided with sunshade structures and appropriately sized air conditioner, if required. Submit temperature calculations for each outdoor enclosure. Sunshade structures shall be constructed as shown on drawings.
- C. Raceways, Conduits, and Fittings:
 - 1. All indoor DRY areas: Galvanized Rigid Steel.
 - 2. All indoor WET areas: PVC Coated Galvanized Rigid Steel.
 - 3. All indoor PROCESS areas: PVC Coated Galvanized Rigid Steel.
 - 4. All indoor CORROSIVE areas: PVC Coated Galvanized Rigid Steel.
 - 5. Indoor MBR building and Blower building as indicated on the drawings: Aluminum conduit and rigid Galvanized Steel Ventilated Cable Tray.
 - 6. All exposed OUTDOOR AREAS: Galvanized Rigid Steel.
 - 7. All underground direct buried: Schedule 80 PVC.
 - 8. All underground concrete encased or concrete capped: Schedule 40 PVC.
 - 9. All FINISHED office areas (120V): Intermediate Metal Conduit. EMT may be used where conduit is concealed.
 - 10. HAZARDOUS classified areas: Meet the NEC requirements for the environment in which it is installed.
- D. Wires and Cables:
 - 1. All Medium-Voltage wiring: MV105.
 - 2. All Feeder wiring: RHW or XHHW-2.
 - 3. All indoor power wiring: XHHW-2
 - 4. All 120V indoor light and convenience receptacle circuits wiring: THWN.

- 5. Cable tray wiring in MBR building: Multi-conductor THHN/THWN type TC, stranded power and control wiring.
- 6. All other power wiring: XHHW-2.
- 7. 120 V control Wiring: THHW/THWN.

- 8. Specialty wires and cables as indicated in individual specification sections, as indicated on the drawings, or as recommended by associated equipment manufacturers, upon ENGINEER approval.
- E. Electrical Equipment:
 - 1. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at the environmental conditions at the site..
 - 2. All electrical devices and equipment shall have ratings based on 75 degrees C (167 degrees F) terminations, minimum.
 - 3. Mounting of electrical equipment on handrails is not allowed.
- F. Hangers and Supports
 - 1. All indoor DRY NON-PROCESS areas: Galvanized Steel.
 - 2. All indoor WET areas: 316 Stainless Steel.
 - 3. All indoor PROCESS areas: Powder Coated Steel.
 - 4. All indoor CORROSIVE areas: 316 Stainless Steel.
 - 5. All exposed OUTDOOR AREAS: 316 Stainless Steel.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.
- B. Determine exact locations for concealed conduit stub-ups. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate concealed conduits before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the ENGINEER may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetration and slots.

3.2 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a workmanlike manner and be in compliance with modifications and repair to concrete as specified in Division 01, General Requirements. Saw cut concrete and masonry prior to breaking out sections.
- B. Core drill holes in concrete floors and walls as required.
- C. Coordinate work at such time as to require the minimum amount of cutting and patching.
- D. Do not cut joists, beams, girders, columns or any other structural members.

- E. Cut opening only large enough to allow easy installation of the conduit.
- F. Patching to be of the same kind and quality of material as was removed.
- G. The completed patching work shall restore the surface to its original appearance or better.
- H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- I. Remove rubble and excess patching materials from the premises.
- J. When existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material.

3.3 INSTALLATION

- A. Work not installed according to the Drawings and Specification shall be subject to change as directed by the ENGINEER at CONTRACTOR's expense.
- B. Electrical equipment shall be protected against mechanical and water damage. Store all electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.
- C. Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the ENGINEER's discretion and at the CONTRACTOR's expense.
- D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted at the CONTRACTOR's expense.

3.4 MANUFACTURERS SERVICE

- A. Provide manufacturer's services for testing and start-up of the following equipment:
 - 1. 12.47 kV Switchgear
 - 2. Pad Mounted Transformer (Dry-Type) (5 days 1 trip minimum)
 - 3. Substation Transformer (Liquid Filled) (5 days 1 trip minimum)
 - 4. 480 Volt Switchboard
 - 5. 480 Volt Motor Control Centers
 - 6. Fire Alarm System
 - 7. Security Alarm System
 - 8. Card Access Control System
 - 9. Gate Security System
 - 10. Perimeter Security System
 - 11. Fiber Optic Network System

- (5 days 1 trip minimum)

- 12. Adequate time shall be provided in the projects scope to provide testing and startup for equipment as listed above to deliver a fully functional system to the OWNER upon completion of the Work.
- B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturer's warranty repairs.

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(5 days 1 trip minimum) (5 days 1 trip minimum)
3.5 TRAINING

- A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the equipment furnished under Division 26, Electrical. (1 days 1 trip minimum)
 - 1. 12.47 Volt Switchgear
 - 2. Pad Mounted Transformers (Dry-Type) (1 days 1 trip minimum)
 - 3. Substation Transformers (Liquid Filled) (1 days 1 trip minimum)
 - 4. 480 Volt Switchboard
 - 5. 480 Volt Motor Control Centers
 - 6. Fire Alarm System
 - 7. Security Alarm System
 - 8. Card Access System
 - 9. Gate Security System

- (1 days 1 trip minimum) (1 days 1 trip minimum)
- 10. Perimeter Security System
- (1 days 1 trip minimum)
- 11. Adequate training time shall be included in the project scope to provide two training sessions to train the OWNER's electrical team on all equipment listed above for which they will be responsible to maintain. For high- and medium-voltage equipment that is to be maintained by Provo Power, an additional training session may also be required and is to be included in the project scope
- B. The cost of training programs to be conducted with OWNER's personnel shall be included in the Contract Price. The training and instruction shall be directly related to the system being supplied.
- C. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of each system.
- E. All training schedules shall be coordinated with and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule.
- F. Within 120 days of contract award to the CONTRACTOR, submit an overview of the proposed training plan. This overview shall include, for each course proposed:
 - 1. An overview of the training plan.
 - 2. Course title and objectives.
 - 3. Prerequisite training and experience of attendees.
 - 4. Recommended types of attendees.
 - 5. Course Content A topical outline.
 - 6. Course Duration.
 - 7. Course Location Training center or job site.
 - 8. Course Format Lecture, laboratory demonstration, etc.
 - 9. Schedule of training courses including dates, duration and locations of each class.
 - 10. Resumes of the instructors who will actually implement the plan.
- G. The ENGINEER will review the training plan submittal with the OWNER.

++ END OF SECTION ++

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SECTION 26 05 13

MEDIUM VOLTAGE CABLE

<u> PART 1 - GENERAL</u>

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install medium voltage cable and shall retain the services of an independent testing firm to perform acceptance testing of the cable installation. The cable shall be installed in conduits and cable trays.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Codes: Install cable in accordance with the current standards and recommendations of the National Electrical Code and with any applicable local codes. Where discrepancies arise between codes, the most restrictive regulation shall apply.
 - 2. Tests by Independent Regulatory Agencies: Cable shall bear the label of the Underwriters' Laboratories, Incorporated.
 - 3. Utilities:
 - a. Work in connection with the utility service shall be done in strict conformance with the requirements of Provo Power and Rocky Mountain Power guidelines.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
 - 1. National Electrical Code (NEC) current adoption.
 - 2. ASTM B3, Uncoated Annealed Copper Conductors.
 - 3. ASTM B8, Specification for Concentric Lay Stranded Copper Conductors.
 - 4. ASTM B33, Tin Coated Conductors.
 - 5. ASTM B189, Lead or Alloy Coated Conductors.
 - 6. ASTM B230, Aluminum, 1350-H19 Wire for Electrical Purposes.
 - 7. ASTM B231, Aluminum 1350 Conductors, Concentric-Lay-Stranded.
 - 8. ASTM B609, Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes.
 - 9. UL 1072, Revised Outline of Requirements for Medium Voltage Cables.
 - 10. ANSI C2, National Electrical Safety Code.
 - 11. NETA, InterNational Electrical Testing Association.
 - 12. IEEE 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 KV through 765 KV.
 - 13. IEEE 404, Standard for Cable Joints for use with Extruded Dielectric Cable Rated 5000-138,000 V and Cable Joints for use with Laminated Dielectric Cable Rated 2500-500,000 V.
- C. The general construction of the cable and the insulation material used shall be similar to that used for cable of the same size and rating in continuous production for at least 20 years and successfully operating in the field in substantial quantities.
- D. Factory Production Tests:

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- 1. Conductors shall meet the electrical resistance requirements of ICEA-69-516 Section 2.5.
- 2. Final Voltage and Insulation Resistance Test: The completed cable, while on the shipping reel, shall be tested at room temperature at a minimum of 25 KVDC for one minute. Insulation Resistance test shall be performed in accordance with the requirements of ICEA S-68-516, Part 6.28. Each cable shall have an insulation resistance not less than that corresponding to the insulation resistance constant of 20,000 megohms per 1000 feet at 15.6 degrees C (60 degrees F).
- 3. Qualification Discharge Resistance Test: A high voltage AC and DC test shall be performed in accordance with Part 6.27 of ICEA S-68-516. The AC and DC test voltages shall be in accordance with Section B of AEIC CS6.
- 4. Shield resistance shall be measured and recorded from end to end on the completed cable.
- 5. Corona Test: Each reel of completed shield power cable shall be partial discharge tested in accordance with Sections E and F of AEIC CS6.
- 6. Energy Suppression Layer Test: The inner energy suppression layer shall be tested during manufacture at 1 KV DC test between electrodes and conductor to prove its electrical integrity. Dielectric breakdown indicating a weakness in this layer shall be eliminated by cutting the cable at the failure point or stripping of the entire manufacturing length and re-insulating.
- E. Testing Firm Qualifications: The independent testing firm shall have experience in the inspection and testing of cables of the type specified and shall be NETA certified.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's catalog cuts and technical information indicating compliance with this Section. Any exceptions shall be stated and completely explained.
 - 2. Literature identifying the methods and materials which CONTRACTOR proposes to use to make splices and terminations. Submittal shall consist of manufacturers' literature evidencing compatibility of the conductor insulation, shield and jacket of the cable with the splicing or terminating materials and methods which CONTRACTOR proposes to use.
 - 3. Listing of cable sizes to be furnished.
 - 4. Listing of locations where splices are proposed.
 - 5. Qualifications of splicing and termination personnel and testing firm.
- B. Test Reports: Submit for approval copies of factory tests and field acceptance testing. Acceptance testing procedures shall be submitted in advance prior to actual testing. Test reports shall indicate results of all testing.
- C. Record Drawings: Include the actual location and routing of all installations of medium voltage cables on Record Drawings in accordance with the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Cable insulation shall be thermosetting rubber-based ethylene propylene rubber (EPR) compound over an extruded, non-conducting high dielectric stress control strand screen layer, with a semi-conducting screen layer applied directly over the

primary

insulation. Medium voltage cable shall be shielded unless specifically shown otherwise on the Drawings. Concentric neutral where shown on the drawings. Suitable for normal installation, indoors or outdoors, in conduit, in air, and intermittent or continuous submersion in water, in underground duct systems, and direct buried installation. Cable for use in cable tray (for all or part of run) shall be UL listed "Type MV 105 for TC use".

- B. Cable Ratings:
 - 1. 5 kV Cable
 - a. Cable type: Single conductor.
 - b. Insulation level as required as required by UL 1072: 115 mils/133 percent.
 - c. Operating voltage; 4160 V, 3 Ph, 60 Hz, grounded distribution system.
 - 2. 15 kV Cable
 - a. Cable type: Single conductor.
 - b. Insulation level as required as required by UL 1072: 220 mils/133 percent.
 - c. Operating voltage; 12,470 V, 3 Ph, 60 Hz, grounded distribution system.
- C. MV-105 Materials:
 - 1. Cable shall be single conductor bearing UL label "Type MV 105" and comply with or exceed ICEA S-693-639 and AEIC S-97-682.
 - 2. Conductors: All conductors shall be aluminum with concentric-lay Class B round stranding in accordance with the current ASTM Standard B800 and B836.
 - 3. Insulation System: The insulation system shall be composed of an extruded inner layer of non-conducting energy suppression or semi-conducting material. The primary insulation shall be a high quality ozone resistant thermosetting rubber based compound. The insulation system shall be suitable for use at conductor temperatures not exceeding 105 degrees C (221 degrees F) for normal operation, 140 degrees C (284 degrees F) for emergency overload conditions, and 250 degrees C (482 degrees F) for short circuit conditions. The minimum thickness at any part of the cable shall not be less than 90 percent of the specified average.
 - 4. Insulation Screen: Insulation screen shall be extruded, strippable, semi-conducting, cross-linked copolymer applied directly over the insulation.
 - 5. Insulation Shield: The insulation shield shall consist of a copper tape applied helically with 12.5 percent nominal overlap. Embedded drain wires are not acceptable
 - 6. Neutral: 33% concentric neutral with mylar tape shield where shown on the drawings.
 - 7. Jacket: A continuous jacket of moisture, heat, oil resistant black polyvinyl chloride shall be applied over the insulation and shielding system. Cables for use in cable tray shall have a jacket of vulcanized, chlorosulfonated polyethylene. The average minimum thickness of the jacket at any point of the cable shall not be less than 60 mils.
 - 8. Product and Manufacturer: Provide one of the following:
 - a. Okonite Company
 - b. General Cable
 - c. SouthWire
 - d. Or engineer approved equal
- D. MV-90 Materials:
 - 1. Cable shall be single conductor bearing UL label "MV 90" and comply with or exceed ICEA S-93-639 and AEIC CS6-87.
 - 2. Conductor: All conductors shall be aluminum with concentric-lay Class B round stranding in accordance with the current ASTM Standards B 8, and either B 33 or B 189.

- 3. Insulation System: The cable insulation system shall include two separate shield layers and the primary insulation.
 - a. Conductor shield shall consist of an extruded inner layer of non-conducting energy suppression or semi-conducting material.
 - b. Primary insulation shall be a high quality ozone resistant ethylene-propylene rubber based compound. The insulation system shall be suitable for use at conductor temperatures not exceeding 90 degrees C (194 degrees F) for normal operation, 130 degrees C (266 degrees F) for emergency overload conditions, and 250 degrees C (482 degrees F) for short circuit conditions. The minimum thickness at any part of the cable shall not be less than 90 percent of the specified average.
 - c. Insulation shield shall be an outer layer of semi-conducting material consisting of a five mil copper tape applied helically with a minimum 12-1/2 percent overlap.
- 4. Jacket: A continuous jacket of moisture, heat, oil resistant black polyvinyl chloride shall be applied over the insulation and shielding system. The average minimum thickness of the jacket at any point of the cable shall be in accordance with ICEA S-93-639 Table 4-3.
- 5. Product and Manufacturer: Provide one of the following:
 - a. Okonite Company
 - b. General Cable
 - c. SouthWire
 - d. Or engineer approved equal
- E. Cable Connectors:
 - 1. All connectors shall be copper, tin-plated, long barrel compression type. Suitable for voltage applications up to 35 KV.
 - 2. For sizes 250 MCM and larger, connectors shall be two-hole mount type with provisions for two bolts for joining to apparatus terminal.
 - 3. Product and Manufacturer: Provide one of the following :
 - a. HYLUG Burndy by Hubbell
 - b. Thomas & Betts
 - c. Or engineer approved equal
- F. Cable Terminations:
 - 1. All cable terminations shall meet Class 1 requirements of IEEE 48.
 - 2. Terminations shall be of the molded elastomer heat-shrinkable types or cold shrink types, with grounding provisions for the cable shielding.
 - 3. Product and Manufacturer: Provide one of the following :
 - a. Elastimold Thomas & Betts
 - b. G&W Electric Company
 - c. Raychem Coporation
 - d. 3M Company
 - e. Or engineer approved equal
- G. Cable Splices:
 - 1. All cable splices shall be made using standard splice kits which reinstate the cable's insulation and jacket, and continue the metallic shielding through the entire cable joint.
 - 2. Splices shall be premolded, conventional tape, cold shrink type, or heat-shrinkable type.
 - 3. Product and Manufacturer: Provide one of the following :
 - a. Elastimold Thomas & Betts
 - b. G&W Electric Company

- c. Raychem Corporation
- d. 3M Company
- e. Or engineer approved equal
- H. Indoor Cable Termination (5 and 15 kV)
 - 1. Single conductor shielded cable terminations for indoor applications shall be one piece, track resistant EPDM rubber with top seal and ground strap assemblies.
 - 2. Termination shall have a current rating equal to, or greater than the cable ampacity.
 - 3. Termination shall accommodate any form of cable shielding or construction without the need for special adapters.
 - 4. Product and Manufacturer: Provide one of the following :
 - a. Cold Shrink Quick Term QT III, 7620-T Series 3M Company
 - b. HVT Series Raychem Corporation.
 - c. Elastimold Thomas & Betts
 - d. Or engineer approved equal
- I. Outdoor Cable Terminations (5 and 15 kV)
 - 1. Single conductor shielded cable terminations for outdoor protected or exposed locations shall be one piece, track resistant silicone rubber with top seal, rain skirt and ground strap assemblies. Cable compartments of outdoor metal clad switchgear shall be considered as outdoor locations.
 - 2. Termination shall have a current rating equal to, or greater than the cable ampacity.
 - 3. Termination shall accommodate any form of cable shielding or construction without the need for special adapters.
 - 4. Product and Manufacturer: Provide one of the following :
 - a. Cold Shrink Quick Term QT III, 7620-S Series 3M Company
 - b. HVT Series Raychem Corporation
 - c. Elastimold Thomas & Betts
 - d. Or engineer approved equal
- J. Single conductor 25/35 kV shielded cable terminations for indoor or outdoor applications:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Elastimold, 35 MTG Series
 - b. 3M Company 25 KV QT III 7690-T Series (Indoor) or QT III 7690-S (Outdoor); 35 KV QT III 7680-S (Outdoor)
 - c. Or engineer approved equal
- K. Single conductor 15/25/35 kV concentric neutral cable terminations:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. 3M Company, Cold Shrink 7640-T Series (Indoor), Cold Shrink 7640-S Series (Outdoor), except where load break elbows are specified in the specifications.
 - b. Or engineer approved equal
- L. Tape Shielded Inline and Tee and Multi-point Cable Splice
 - 1. Splice all shielded cables rated 15,000 V or less with conductor sizes ranging from No. 4 to 1,000 Kcmil in accordance with the instructions provided with inline cold shrink splice kits.
 - a. Product and Manufacturer: Provide one of the following :
 - 1) QS-III 3M Company
 - 2) Scotch Brand Tape Splicing Kits 5717, 5718, 5719 and 5720
 - 3) CAS Series Raychem Corporation
 - 4) Or engineer approved equal

- 2. Shielded cable splices shall be capable of normal continuous operations at the rated voltage and current on the cable it is to be used on (15 kV maximum). The splice kit shall contain all of the necessary materials required to make three splices including cable preparation materials, such as solvents, rags and abrasive materials. The primary insulating tape shall be an all-voltage linerless tape. A comprehensive step-by-step instruction sheet shall be included with each kit.
- 3. 25 and 35 kV cable splices shall be made in accordance with splice drawings furnished by the cable manufacturer.
- 4. Separable connector system 600 AMP, 15/25kV Class; 4 point junction, rack installation in accordance with the instructions provided with the connector system.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) 5810/5811 Loadbreak Series 3M Company
 - 2) 5815 Modular Technology Series 3M Company
 - 3) Raychem
 - 4) Elastimold Thomas & Betts
 - 5) Or engineer approved equal
- M. Transition Splices
 - 1. Splice transition from PILC to EPR cables shall utilize an oil stop design.
 - 2. Product and Manufacturer: Provide one of the following
 - a. Adalet, Type 35TT
 - b. MAC Products, Type RP1T/RP3T
 - c. 3M Company QS-2000T Series
 - d. Or engineer approved equal
- N. Heat Shrinkable Bus Connection Kits
 - 1. Bus kits shall be capable of insulating bus bars 2-in to 6-in wide and for connection of one to four cables. Kits shall electrically insulate and environmentally seal the connection and be easily re-enterable.
 - 2. Cable-to-bus bar connection kits shall be rated up to 15 kV class and tested in accordance with ANSI C37.20c, Section 5.2.1.4 Test for Bus Bar Insulation and Section 5.2.9 Flame-Retardant Test for Applied Insulation.
 - a. Product and Manufacturer: Provide one of the following :
 - 1) Type HVBC Raychem Corporation
 - 2) 3M Company
 - 3) Elastimold Thomas & Betts
 - 4) Or engineer approved equal
- O. Medium Voltage Motor Connection Kits.
 - 1. Motor connection kits shall insulate the motor feeder motor lead connection and allow installation within the motor conduit box.
 - 2. Kits shall environmentally seal the connection and be easily re-enterable.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Type MCK Raychem Corporation
 - 2) 5300 Series 3M Company
 - 3) Or engineer approved equal
- P. Cable end caps shall be heat shrinkable polyelofin
 - 1. Product and Manufacturer: Provide one of the following
 - a. 3M Company Type SKE
 - b. Or engineer approved equal
- Q. Lugs and Connectors

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- 1. Copper lugs and connectors shall be crimped with standard industry tooling. All connections of copper stranded wire in sized No. 6 AWG through 1000 kcmil shall be made electrically and mechanically secured. The lugs and connectors shall have a current carrying capacity equal to the conductors for which they are rated and meet UL 486 requirements. Lugs larger than 4/0 AWG shall be two-hole lugs with NEMA spacing. The lugs and connectors shall be rated for operation through 35 kV. The lugs shall be of closed end construction to exclude moisture migration into the cable conductor.
- R. Electrical Grounding Braid
 - 1. Conducting metal braid shall be woven from 240 strands of 30 AWG tinned copper wires and be capable of carrying fault current comparable to that of 6 AWG copper wire.
 - 2. Product and Manufacturer: Provide one of the following
 - a. 3M Company Scotch braid 25, or equal
 - b. Or engineer approved equal
- S. Cable Marking Systems
 - 1. A 7-mil, flame retardant, cold and weather-resistant vinyl plastic electrical tape shall be used for phase identification, 3M Company Scotch 35 Tape, or equal.
 - 2. Cable tags shall be heat stamped nylon secured by polypropylene cable ties.
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Thomas & Betts No. TC228-TB
 - b. Or engineer approved equal
- T. Separable Surge Arresters
 - 1. MOV surge arresters with IEEE 386 interface, fully shielded, fully submersible, 15kV Class.
 - 2. Product and Manufacturer: Provide one of the following
 - a. Type PSA Elastimold
 - b. Or engineer approved equal

2.2 SECTIONALIZER CABINETS

- A. Construction
 - 1. Cable sectionalizing centers with 600A, 15kV class loadbreak connector systems.
 - 2. continuous seam-welded and manufactured of 12-gauge mild steel.
 - 3. Top hinged removable cover with a wind stop to prevent accidental closing.
 - 4. Configured for one person operation.
 - 5. 3/8" ground bar installed.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Eaton Cooper Power Systems
 - 2. Or engineer approved equal

2.3 PULLING COMPOUNDS

- A. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Ideal Industries
 - b. American Polywater Corporation
 - c. WL Series 3M Company

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d. Or engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all cables complete with proper terminations at both ends. Check for proper phase sequence and proper motor rotation.
- B. Splice and terminate all medium voltage cables in strict accordance with the cable manufacturer's recommendations.
 - 1. Use experienced personnel familiar with the materials and procedures to be employed.
 - 2. Make splices watertight in all cases below grade and submersible in all manholes and handholes.
- C. Pulling:
 - 1. Use insulating types of pulling compounds containing no mineral oil.
 - 2. Limit pulling tension within values recommended by the cable manufacturer.
 - 3. Use a dynamometer where mechanical means are used.
 - 4. Cut off section subject to mechanical means.
- D. Bending Radius: Limit to 12 times cable overall diameter.
- E. Slack: Provide maximum slack without coiling at terminal points and in manholes.
- F. Wrap cables located within manholes, handholes and boxes with fireproofing tape for their entire length on an individual cable basis. Tape shall be 30 mils thick of self-extinguishing material which will not support combustion. Tape shall not deteriorate when subjected to water, salt, sewage or fungus and shall be secured with glass cloth tape. Fireproof cables in accordance with the cable manufacturer's recommendations and then cover with tape extending at least 1-inch into any duct.
- G. Identification: Identify all conductors by circuit number and phase at each terminal and splice location. Plastic nameplates shall be installed in each manhole, pull box and at splice and terminating points. These nameplates shall show the phase and feeder designations and the date when the cable was installed or splice or termination was made. The feeder designation shall be as indicated on the Drawings. Nameplates shall be tied to each cable with self-locking nylon ties.
- H. Color code cables in accordance with OWNER's standard.

3.2 TESTING

- A. Perform acceptance testing of the medium voltage cable system. Each medium voltage cable circuit shall be inspected and tested on an individual per phase basis. All testing and inspection shall be performed by an independent certified testing firm.
- B. Visual and Mechanical Inspection: Perform inspection of each power cable installation in accordance with the latest NETA acceptable testing specifications. All splices and terminations shall be inspected.

- C. Electrical Tests: Perform electrical testing of each power cable in accordance with the latest NETA testing procedures. Testing shall include the following:
 - 1. Shield continuity test.
 - 2. DC high potential test.
 - 3. Adhere to following procedures before performing DC over potential tests:
 - a. Disconnect all equipment including but not limited to transformers, switches, motors, circuit breakers and surge arrestors, from cable circuit to prevent test interruptions due to flashovers or trip outs resulting from excessive leakage current.
 - b. Establish adequate clearance between the circuit test ends and any grounded object and to other equipment not under test.
 - c. Ground all circuit conductors not under test, all cables shields and nearby equipment.
 - d. Clean insulation surfaces.
 - e. Keep cable ends dry.
 - 4. Apply high-potential slowly in eight to ten equal steps to 80 percent of the manufacturer's test value. Record the leakage current at each test voltage and plot the curve on graph paper.
 - 5. Stop test if the leakage current increases excessively or a "knee" appears in the curve before reaching maximum test voltage.
 - 6. Upon reaching the specified maximum test voltage, maintain the voltage for 15 minutes, record the leakage current at 30 seconds and one minute and at one minute intervals thereafter. Plot leakage current versus time on the same graph as the step voltage curve.
 - 7. Reduce conductor test potential to zero and measure residual voltage at discrete intervals.
 - 8. Apply ground for a time period adequate to drain charges stored in the insulation.
 - 9. Cable failing the test shall be repaired or replaced and retested. If a test failure occurs on a cable interconnected to an existing cable, notify ENGINEER for further instructions.
 - 10. The test curves shall be signed by the tester, initialed by OWNER'S representative and shall be sent to ENGINEER for review.
- D. Where existing cables are spliced to cables provided under this Contract, the new cables shall be DC high-potential tested prior to splicing. After approval of the new cable test, the splicing shall be made and the entire cable shall be insulation-resistance tested. A shield continuity test shall also be performed. When these tests prove positive, a DC high-potential test shall be performed. Test voltage and procedures shall be in accordance with the latest NETA recommendations. Any cable failure shall be brought to the ENGINEER'S attention.

++ END OF SECTION ++

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install complete grounding for the electrical systems, structures and equipment.
 - 2. Ground rods, building steel, structural rebar, duct bank ground wires, and Pump cans and buried piping shall be bonded to the ground grid.
 - 3. Neutral bonding shall be provided for all transformers, generators and other separately derived systems, and where shown on the drawings.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:
 - 1. National Electrical Code (NEC) Article 250, Grounding.
 - 2. 2. Underwriters Laboratories (UL) Standard No. 467, Electrical Grounding and Bonding Equipment.
 - 3. 3. ANSI-J-STD-607-A, Commercial Building Grounding [Earthing] and Bonding Requirements for Telecommunications.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for grounding materials proposed for use, including round wires, rods, test wells, and connectors.
 - 2. Listing of grounding connector types identifying where they are to be used.
 - 3. Layouts of each structure ground grid.
 - 4. Test point construction details.
 - 5. Ground resistance test procedure.
 - 6. Results of ground resistance tests at each test point.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Ground Wire: Annealed, bare, stranded copper per ASTM B8 or solid per ASTM B 3. Bonding conductor shall be No. 4 or No. 6 AWG stranded.
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Southwire Company
 - b. Service Wire Company

- c. Encore Wire Corporation
- d. Or engineer approved equal
- C. Ground Rods:
 - 1. Material: Copperclad rigid steel rods, 3/4-inch diameter, 10 feet long, one piece.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Erico
 - b. A.B. Chance Company Hubbell
 - c. South Atlantic LLC
 - d. Harger Lighting & Grounding
 - e. Or engineer approved equal
- D. Grounding Connectors:
 - 1. Material: Pressure connectors shall be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Pressure Connectors:
 - 1) O.Z./Gedney Emerson
 - 2) Burndy Hubbell
 - 3) Or engineer approved equal
 - b. Welded Connections:
 - 1) Cadweld Erico
 - 2) Therm-O-Weld by Continental Industries Hubbell
 - 3) Or engineer approved equal
- E. Concrete Boxes:
 - 1. Material: High density reinforced concrete box with non-settling shoulders positioned to maintain grade and facilitate back filling with steel checker plate screw down cover.
 - 2. Size:
 - a. Outside Locations: 15 x 22 inches, minimum.
 - b. Inside Locations: 10 x 17 inches, minimum.
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Concrete Box:
 - 1) Christy Box Model B1017 Oldcastle Infrastructure
 - Or engineer approved equal
 - b. Steel Cover:
 - 1) Christy Box Cover Model B1017-51JH labeled "GROUND" Oldcastle Infrastructure
 - 2) Or engineer approved equal
- F. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressuretreated fir or cypress or cedar.
- G. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- C. Ground Bar: Provide a ground bar in the electrical rooms Connect all equipment to ground bus. Provide 2 jumpers from ground bus to ground ring sized according to the grounding electrode size on the drawings.

3.2 STRUCTURE GROUND SYSTEM

- A. Provide ground grids as shown on the Drawings.
- B. Install a copper ground bus mounted to the wall in the electrical room as shown on the drawings.
- C. Install No. 4/0 AWG bare copper cable. Install the cable around the exterior perimeter of structures, minimum 2 feet, 6 inches below grade, unless otherwise shown on the Drawings.
- D. Install ground rods where shown on the Drawings. Install additional ground rods, if necessary, to attain a resistance to ground of less than five (5) ohms for each ground grid.
- E. For structures with steel columns, install 4/0 AWG ground cable. Install cable from grid to each column around the perimeter of the structure. Connect cable to steel using exothermic welds.
- F. Connect grids to a continuous underground water pipe system, when practical.
- G. Provide concrete ground test wells for measuring the ground resistance of each separately derived power source, including generators, prior to terminating in equipment. Provide 12-inch ground conductor slack loop in each well. Route ground conductor from test well to equipment in PVC conduit.
- H. Weld all buried connections. Test points connections shall utilize pressure connectors.

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3.3 EQUIPMENT GROUNDING

A. Ground all electrical equipment in compliance with the National Electrical Code.

B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where necessary for mechanical protection. Ground

conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.

- C. Panel Grounding:
 - 1. A minimum size of 4/0 AWG bare stranded copper cable shall be installed between the ground grid and the panel enclosure grounding lug. The mounting frame for panels shall be grounded to the ground grid.
 - 2. A minimum size of 6 AWG insulated green stranded copper cable shall be installed between the ground grid and the isolated DC Ground Bus located on the enclosure sub-panel. This ground shall be installed in all panels that provide an isolated DC Ground Bus.
- D. A separate green insulated ground conductor sized per conduit schedule as shown on DRAWINGS or NEC requirements shall be pulled into conduits and connected utilizing grounding conduit bushings.
- E. Connect ground cable to piping by welding or brazing. Use copper bonding jumpers on all gasketed joints. Mechanical grounding clamps may be used.
- F. Connect ground cable to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not install with hold down bolts. Where grounding provisions are not included, drill suitable holes in locations designated by ENGINEER.
- G. Connect to motors by bolting directly to motor frames, not to sole plates or supporting structures.
- H. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.
- I. Ground all electrical and mechanical equipment frames to ground. Connect outdoor metallic equipment and tank frames to a ground rod or an adjacent ground ring.
- J. Connect surge protective devices to ground.
- K. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- L. Scrape bolted surfaces clean and coat with a conductive oxide- resistant compound.
- M. Test all system grounding conductors for continuity of connection and electrical equipment. Provide in the final report a statement on equipment that was tested and document any discrepancies noted during the tests.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished

floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 INSTALLATION

- A. Grounding Conductors: CONTRACTOR to determine efficient route along shortest and straightest paths possible, unless otherwise indicated or required by Code.
- B. Bonding Grounding system with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Bonding and Grounding for Fencing: For fencing around substations or electrical gear provide listed bonding connectors on each fence post. Connect to area ground grid with minimum #4/0 SDBC grounding conductors. Provide flexible, listed bonding straps across

all hinges on all fence gates. Measure resistance to ground using fall-of-potential method and provide OWNER with certified test results.

- G. Grounding and Bonding for Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- H. Grounding for Steel Building Structure: Exothermically bond ground grid to building steel at locations shown on the drawings.
- I. Ground Ring: Install a grounding ring around building or steel structures as shown on the drawings.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 GROUND GRID TESTING

- A. The CONTRACTOR shall contract the Testing Firm to provide testing of the grounding electrode system as shown on drawings.
 - 1. Performing the following ground single point test:
 - a. Conduct test at the testing point(s) locations as shown on the drawings using a clamp-on ground tester.
 - 2. Utilize the following test equipment:
 - a. Fluke, Model 1625 Kit or equal.
 - b. Visually inspect the installed ground reference electrode or ground rods. Verify that they are intact and accessible. Measure the ground system at these test points with the clamp-on meter. The results shall be recorded and submitted for OWNER approval.
 - c. Proved a Serial Key number for each test point shown on the DRAWINGS. Coordinate with OWNER to determine the Serial Key number. Update the RECORD DRAWINGS with the Serial Key number.
 - d. Install metal ground test point tags identified with a Serial Key number at each test point using stainless steel wire and zinc wire clamps. For any test points within equipment, attach test point tag to exterior of equipment with epoxy.
 - e. Digitally Photograph clamp-on meter in place during test and include with test data sheets. Digital images shall have the Serial Key identified for reference. Digital images of these test points with the clamp-on tester in place are to provide a visual representation of the proper clamp-on testing placement and method and shall be inserted into the ground test sheet document.

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- B. Install grounding test tags for each grounding test. Provide the following for each tag. Install tag with epoxy if unable to utilize wire and clamp.
- C. Tests shall be witnessed by the ENGINEER and OWNER.

++ END OF SECTION ++

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install underground duct banks including all labor, materials, equipment and incidentals as shown on the Drawings and specified for a complete system.
- B. Coordinate installation with piping and other underground systems and structures. Provide supports for traversing existing underground facilities.
- C. Provide bases for pad mounted electrical equipment per Provo Power Commercial Reference Book, Provo City Power Standards.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the National Electrical Code.
- B. Materials shall be UL listed where applicable.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Plans showing the proposed routing of duct banks and the locations of manholes, handholes and indicate burial depth and duct bank construction at each location.
 - 2. Profiles of duct banks showing crossings with piping and other underground systems.
 - 3. Typical cross sections.
 - 4. Concrete pad and vault information:
 - a. Detailed drawings
 - b. Structural calculations
 - c. Catalog information:
 - 1) Manholes, hand holes, and vaults
 - 2) Vault accessories
- B. Record Drawings: Include the actual routing of underground duct runs on Record Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Duct: Schedule 40 PVC conduit and fittings. Fiberglass conduit in non-traffic areas may be acceptable where permitted by the owner. Fiberglass conduit shall be UL 2420 listed for below ground installations, Reinforced Thermosetting Resin Conduit (RTRC), resin

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system shall be epoxy based, with no fillers, using an anhydride curing agent. The fiberglass shall consist of continuous E-glass Grade "A" roving

- B. Provide red colored concrete cap and warning tape over all duct banks. Concrete cap shall extend 3 inches beyond edge of outside conduits.
- C. Exposed: PVC Coated Galvanized Rigid Metal Conduit: PVC coated rigid metal conduit and fittings.
- D. Backfill: Select electrical duct bank backfill in accordance with the specifications. Backfill material around duct bank conduits must have a thermal resistivity less than 90°C cm/W.
- E. Reinforcement: In accordance with the specifications.
- F. Concrete: In accordance with the specifications.
- G. Padmounted transformer and Padmounted Switchgear pad and Vault in accordance with Provo Standard "Services Larger than 800 Amp 3 Phase Transformer Pad Specification."
- H. Sectionalizer pad in accordance with Provo Standard "Underground Distribution Specification (3 Phase)."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install outdoor equipment pads such that the electrical terminals are 3 feet above finished grade minimum.
- B. Separation of Duct Banks systems:
 - 1. The following systems shall be routed in separate duct banks:
 - a. Control and signal 48 V and less.
 - b. Power and control 120 V.
 - c. Power greater than 120V and less than 1000 V.
 - d. Power 1000 V and greater.
 - 2. The following systems shall be routed in separate hand holes and manholes:
 - a. Control and signal 48 V and less and power and control 120 V.
 - b. Power greater than 120 V and less than 1000 V.
 - c. Power 1000 V and greater.
 - d. Manholes shall be sized as shown on the contract drawings.
- C. All bends (vertical and horizontal) of 45 degrees or more require PVC coated rigid metal conduit or fiberglass conduit.
- D. Excavation and backfilling required for duct bank installation.
- E. All duct bank installations and penetrations through foundation walls shall be watertight and in accordance with the specifications.
- F. Top of duct banks shall be as follows:

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- 1. 1000V and below minimum of 24 inches below grade, unless otherwise approved by the ENGINEER.
- 2. Greater than 1000V 48 inches below grade.
- 3. Duct banks may vary for short distances to avoid underground interferences as approved by the ENGINEER.
- G. Assemble duct banks using non-magnetic saddles, spacers and separators. Position the separators to provide 3 inches minimum concrete separation between the outer surfaces of the ducts. Side forms are only required to prevent excessive widening of the duct bank where over excavation has occurred.
- H. Provide a 3-inch minimum concrete covering on sides, top and bottom of concrete envelopes around conduits. Concrete covering size shall be as shown on the Drawings. Add red oxide to concrete for easy identification during subsequent excavation. The red oxide is to be added in the concrete truck prior to the concrete being placed. Red oxide concrete shall include the entire duct bank, top and bottom unless under a slab.
- I. Firmly fix ducts in place during placing of concrete. Carefully place and vibrate the concrete to ensure filling of all spaces between ducts.
- J. Conduits entering floor mounted equipment, such as, switchgear compartments, motor control centers, transformers shall terminate with PVC coated rigid metal conduit factory 90° elbows, RNC risers and bell ends.
- K. Reinforce all duct banks.
 - 1. Unless otherwise shown on the Drawings, reinforce with No. 4 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 18 inches on centers, and No. 3 tie-bars transversely placed at 18 inches maximum longitudinal intervals. Overlap of No. 3 tie-bars shall be a minimum of 4-inches.
 - 2. Maintain a maximum clearance of 1 inch from bars to the edge of the concrete encasement.
 - 3. Install dowel reinforcement rebar where duct bank meets other concrete structures.
- L. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.
- M. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.
- N. Install a bare stranded copper duct bank ground cable (4/0 or as shown on drawings) in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Terminate ground cable at last manhole or handhole for outlying structures.
- O. After completion of the duct bank or utilizing existing ducts and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag

swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.

- P. Pulling Rope/Tape
 - 1. Pulling rope or tape shall be constructed of polyester and factory lubricated. Nylon is not allowed.
- Q. Plug and seal empty spare ducts entering buildings and structures. Install pulling tape in all empty spare ducts. Seal watertight all ducts in use entering buildings and structures in accordance with the specifications.

++ END OF SECTION ++

SECTION 26 05 45

MANHOLES AND HANDHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install manholes and handholes.
- B. Coordination:
 - 1. Coordinate manhole and handhole installation with piping, sheeting and other underground systems and structures and locate clear of interferences.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:
 - 1. National Electrical Code (NEC) current adoption.
 - 2. Materials shall be UL listed where applicable.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for manholes, handholes and accessories proposed for use.
 - 2. Drawings showing interior and exterior dimensions and details of openings, jointing, inserts and reinforcing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material and Construction:
 - 1. Precast or cast-in-place type of reinforced concrete. Composite manholes and covers for handholes smaller the 4 feet in any dimension may be acceptable if approved by the owner. Composite manhole shall be single-piece, factory integrated, light weight, and corrosion resistant.
 - 2. Minimum interior dimensions as shown on the Drawings.
 - 3. Duct entrances sized and located to suit duct banks.
 - 4. Handholes and Manholes must have a bottom.
- B. Accessories:
 - 1. Frames and Covers:
 - a. Material: Cast iron conforming to ASTM A 48, Class 30A.
 - b. Covers: Watertight, sealed type marked "ELECTRICAL" in raised 2-inch letters. Identify covers as shown on the Drawings.
 - 1) Manhole covers to be 36 inches minimum.

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- c. Frame shall be grouted on the manhole or handhole.
- d. Product and Manufacturer: Provide one of the following:
 - 1) Neenah Foundry Company
 - 2) Campbell Foundry Company
 - 3) Or engineer approved equal
- 2. Pulling Irons:
 - a. Material: Galvanized steel.
 - b. Cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.
 - c. Product and Manufacturer: Provide one of the following:
 - 1) 8119 by Chance Utility Hubbell
 - 2) Inwesco Inc
 - 3) Or engineer approved equal
- 3. Cable Racks:
 - a. Material: Galvanized steel.
 - b. Cable racks shall adequately support cables with space allowed for future cables.
 - c. Each rack shall be a vertical assembly of 24-inch cable racks extending from within 6-inches of the manhole roof slab to within 6 inches of the manhole floor.
 - d. Product and Manufacturer: Provide one of the following:
 - 1) J-5125 MacLean Power Systems
 - 2) C203-1125 by Chance Utility Hubbell
 - 3) Or engineer approved equal
- 4. Cable Hooks:
 - a. Material: Galvanized steel.
 - b. Length: 7-1/2-inch minimum.
 - c. Product and Manufacturer: Provide one of the following:
 - 1) J-5132A MacLean Power Systems
 - 2) C203-1132 by Chance Utility Hubbell
 - 3) Or engineer approved equal
- 5. Insulators:
 - a. Material: Porcelain.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) J-5122 MacLean Power Systems
 - 2) C203-1120 by Chance Utility Hubbell
 - 3) Or engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install manholes and handholes where shown on the Drawings. Verify final locations in field. Responsibility belongs to CONTRACTOR for all excavation and backfilling required for installation.
- B. Complete installation of manholes and handholes so that structures are watertight. Apply foam sealant to all openings and penetrations. Seal all conduit openings to provide a water/bug-tight seal.
 - 1. Product and Manufacturers:
 - a. DUX Duct Sealing Compound O-Z/Gedney Emerson

b. Type FST Foam Sealant – American Polywater Corp

- C. Cable Supports in Manholes:
 - 1. Attach cable racks with 3-inch by 3/8-inch diameter "tamp-in" studs mounted in 1-inch holes drilled into walls of manholes in the absence of inserts. Apply PVC coating to all racks.
 - 2. Provide cable hooks to support each cable on each rack along the cable run within the manholes. Apply PVC coating to all hooks.
 - 3. Individually support each cable at each hook on porcelain insulators. Provide sufficient slack for each cable.
 - 4. Securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non-metallic 3/4-inch strapping tape as manufactured by 3M or tie down with nylon straps.
- D. Grounding: Install a 3/4-inch by 10-foot copper-clad ground rod for each manhole. Bond all exposed metal manhole accessories and the concrete reinforcing rods with No. 4 AWG minimum bare copper wire and connect to the ground rod and to the duct bank ground cable.
- E. Sump: Provide a 12-inch by 12-inch by 6-inch sump in manhole floor.
- F. Provide grading rings for manholes when required to adjust cover to proper grade. Grading ring shall be minimum of 12 inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the grading ring shall be such as is necessary to bring the frame to the proper grade.
- G. Metal Pullbox: only where explicitly shown on the drawings install NEMA 4X stainless steel wall mounted pullbox inside manholes/handholes where analog signal cables are mixed with power cables. Route conduits for analog cables directly into and out of metal pullbox so that no analog cables are exposed.

++ END OF SECTION ++

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SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide identification nameplates and labels in accordance with this Section and the drawings for the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Conduits and cables shall be identified as indicated on the drawings.

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2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker tags: heat shrink wire tags, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core with red polyethylene film on top and with clear polyethylene film on the bottom.
 - 4. Printed legend shall indicate type of underground line and "<u>CAUTION BURIED</u> <u>ELECTRIC LINE BELOW</u>".
- B. Product and Manufacturer: Provide one of the following:
 - 1. Identoline, "Buried Underground Tape" Brady Coporation
 - 2. Thomas & Betts
 - 3. Or engineer approved equal

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive 2-sided adhesive tape, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Letters shall be 3/4 inch. Font shall be capitalized block characters. White letters on black.
- D. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- E. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES "

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
- B. Letters shall be 3/4 inch. Font shall be capitalized block characters. White letters on black.
- C. Punched or drilled for mechanical fasteners.
- D. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black. Minimum letter height shall be 3/4 inch. Font shall be capitalized block characters.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: In accordance with the specifications.
 - 4. Color: Black, except where used for color-coding.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

1.

- B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No.1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

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- 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. Install warning ribbon approximately 12 inches below finished grade and centered on direct buried cables, electrical ductbanks and conduits without ductbank encasement.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- G. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1 1/2-inch high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Electrical substations.

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- f. Emergency system boxes and enclosures.
- g. Motor-control centers.
- h. Disconnect switches.
- i. Enclosed circuit breakers.
- j. Motor starters.
- k. Push-button stations.
- I. Power transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery inverter units.
- p. Battery racks.
- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Monitoring and control equipment.
- t. Uninterruptible power supply equipment.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Color-Coding for Phase Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Colors for 208/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 2. Colors for 480/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps

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are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.3 EQUIPMENT IDENTIFICATION

- A. Provide identification of each electrical item, in addition to the manufacturer's nameplates, to identify the item's function, and the equipment or system which it serves or controls.
- B. Identify equipment by means of nameplates. Re-label existing equipment whose designation has been changed.
- C. Identify pull and terminal boxes with nameplates. Identify each box by a unique number. Numbering system shall reflect the actual designations used in the field and as documented on wiring diagrams.
- D. Process/Mechanical/Electrical equipment located outdoors shall be labeled by the manufacturer: "For Outdoor Use".
- E. Equipment Voltage Labels:
 - 1. Voltage labels shall be installed on all equipment that has voltage in the equipment.
 - 2. Where applicable, install voltage label below the Arc Flash Warning label.
 - 3. If the equipment has access to the backs or side of the gear, apply voltage labels on all access panels.
 - 4. Provide standard 3 1/2-inch by 5-inch, Black/Red on White rectangular labels to match Figure 3.1.A below.
 - 5. Apply a "Danger High Voltage" label to all medium equipment greater than 600 V.
 - 6. Product and Manufacture: Provide the following:
 - a. BRADY
 - 1) DANGER 120 VOLTS, Part # 86784
 - 2) DANGER 208 VOLTS, Part # 86782
 - 3) DANGER 240 VOLTS, Part # 86785
 - 4) DANGER 480 VOLTS, Part # 86783
 - 5) DANGER HIGH VOLTAGE INSIDE, Part # 86861
 - b. Or Equal



Figure 3-1. A

F. Service Entrance Sections:

- 1. Install a Danger Electrical Hazard & Voltage placard on the front side of all Service Entrance Sections.
 - a. Placard to be Black/Red on White on aluminum and size to be 7-inch by 10inch to match Figure 3.2.B below.
 - b. Install 1 3/4-inch x 3 1/2-inch, type printed, high performance polyester appropriate voltage level labels on the placard. Hand written is not allowed
- 2. If the Service Entrance Section has access to the backs or side of the gear, apply voltage labels per Paragraph 2.2.C above and Arc Flash Potential Warning labels per Paragraph 2.2.B.2 on all access panels at each main breaker.
- 3. Product and Manufacture: Provide the following:
 - a. BRADY
 - 1) DANGER _____ VOLTS, Part # 43141
 - b. Or Equal



Figure 3-2. B

G. Utility Sections:

- 1. When the Utility Sections has access to the back, apply a standard 3 1/2-inch by 5inch, Black/Red on White rectangular "Danger" label stating to match Figure 3.3.C below and Arc Flash Potential Warning labels.
- 2. Product and Manufacture: Provide the following:
 - a. BRADY
 - b. Or Equal



Figure 3-3. C

- H. Additional Sources of Power:
 - 1. When more than one source of power is located inside the equipment apply standard 3 1/3-inch by 5-inch, Black/Red on White rectangular "Danger" label stating to match Figure 3.4.D below.
 - 2. Product and Manufacture: Provide the following:
 - a. BRADY
 - b. Or Equal



Figure 3-4. D
- I. Generator Power Sources:
 - 1. There are to be no Arc Flash Potential Labels printed or applied pertaining to any system that has generation power as an alternate source. For these sites apply at the automatic transfer switch a standard 3 1/2-inch by 5-inch, Black on Orange "WARNING" label stating to match Figure 3.5.E below
 - 2. Product and Manufacture: Provide the following:
 - a. BRADY
 - b. Or Equal



Figure 3-5. E

++ END OF SECTION ++

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SECTION 26 05 73

POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General:
 - 1. The CONTRACTOR shall Obtain and pay for the services of an electrical distribution equipment manufacturer or engineering firm, subject to the approval of the ENGINEER, here-in be referred to as ANALYSIS FIRM, to perform the POWER SYSTEM / ARC FLASH ANALYSIS.
 - The Power System / Arc Flash Analysis shall consist of a preliminary and final Power System Short Circuit Study, Protective Device Coordination Study, load flow study, Device Evaluation, Harmonic Study, Motor Starting Study, voltage drop calculation, power factor calculation, and Arc Flash Analysis for the entire Electrical Distribution System (EDS) as specified in the CONTRACT DOCUMENTS.
 - 3. The software used to conduct the study and analysis shall be the latest version of SKM Power Tools, EDSA, ETAP, or approved equal

1.2 SCOPE

- A. CONTRACTOR Information for Analysis:
 - 1. The CONTRACTOR shall be responsible for providing the following data to the ANALYSIS FIRM:
 - a. Project Schedule.
 - b. Electrical Utility contact information.
 - c. Division 26, Electrical, ENGINEER approved submittals, including the ENGINEER'S review comments.
 - d. Additional equipment information as requested by the ANALYSIS FIRM per Section 1.2.A3.
 - e. Marked up single line diagram(s) with installed conductor lengths, sizes and count.
 - f. Changes in design as a result of RFI's, Addendums, ENGINEER Clarifications, Sketches or revisions, which may affect the Power System / Arc Flash Analysis.
 - 2. Based upon outcome of analysis additional equipment information may be required by the CONTRACTOR for upstream or downstream equipment in the electrical distribution system.
 - 3. CONTRACTOR shall be responsible for implementation of the protective device settings. Implementation of recommended settings outside of the project scope of work resulting from system coordination changes is the responsibility of the OWNER.
 - 4. CONTRACTOR shall provide ANALYSIS FIRM with safe access to all equipment on site throughout construction for the purpose of verifying the EDS protective device information.
 - 5. CONTRACTOR shall install labeling as required by the specifications for voltage labeling and other labels as required.
- B. Analysis firm shall conduct a Power System/Arc Flash Analysis for new and modified areas of the EDS as specified in the CONTRACT DOCUMENTS. The analysis shall be

performed in accordance with IEEE and shall utilize the ANSI method of short circuit analysis. A model of the EDS shall be developed or modified using ENGINEER'S approved Equipment Submittals, site collected data, and Utility short circuit data. Deliverables shall include short circuit analysis results, protective device coordination analysis results, load flow study, Device Evaluation, Harmonic Study, Motor Starting Study, voltage drop calculation, power factor calculation, and arc flash / shock hazard analysis results and work tasks required by the CONTRACTOR. The ANALYSIS FIRM shall coordinate new protective devices with existing protective devices in the EDS as required.

- C. Where additional electrical equipment is being added or modified and upon request from the ANALYSIS FIRM, the ENGINEER will transmit the existing Arc Flash Documentation to the ANALYSIS FIRM for use in completing the required updates.
- D. ANALYSIS FIRM shall acquire the Electrical Utility Company's published available Short Circuit current tables for use in the studies. For larger service sizes greater than 480VAC, the ANALYSIS FIRM is to coordinate with the ENGINEER and Utility Company for calculated available short circuit current.
- E. ANALYSIS firm shall verify that protective devices are correct per model and analysis results.
- F. ANALYSIS FIRM shall install arc flash labels per this specification.
- G. ANALYSIS FIRM shall install the updated laminated Single Line Diagram's, Panel Schedules, and Load Summaries. Updates will be made by the ANALYSIS FIRM based on as-build documentation provided by the CONTRACTOR.
- A. Power System/Arc Flash Analysis shall consist of a complete fault current, device evaluation, protective devices selective coordination, harmonic study, motor starting study, load flow study, voltage drop calculation, power factor calculation, and Arc Flash Analysis. The study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and including the largest feeder circuit breaker and motor starter in the all low voltage motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, Uninterruptible Power Supplies (UPS), power factor correction equipment, transformers and protective devices associated with emergency and standby generators, and the associated paralleling equipment and distribution switchgear. The arc flash study shall begin with the utility company's feeder protective device and include all of the electrical distribution equipment down to and including low voltage motor control centers and power distribution panelboards and lighting panels. The CONTRACTOR shall be responsible for all information required to perform the study.
- B. Submit the preliminary short circuit, selective coordination and motor starting/running study prior to submittal of medium voltage switchgear, 480 Volt switchboard, motor control centers, transformers, and 480 Volt and 120 Volt panelboards shop drawings. The aforementioned shop drawings will not be reviewed until the preliminary power system study is approved by the ENGINEER. No exceptions will be allowed. The preliminary study shall include but not limited to:
 - 1. Obtain and verify with the utility company all information needed to conduct the study. Obtain and verify with the OWNER ratings of existing electrical equipment that shall be included in the study.

- 2. Current transformers' ratio and burden calculations shall be based on a 10 percent maximum ratio error per ANSI C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable ANSI error margins and recommend corrective action.
- 3. The preliminary study shall verify equipment is being applied within their design ratings and electrical protective devices will coordinate.
- 4. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective to the OWNER.
- C. After release of electrical equipment by the manufacturer, but prior to energizing the electrical equipment, submit the final short circuit and selective coordination study including all calculations, tabulations, protective devices coordination graphs, etc. as specified herein.
 - 1. Provide a complete short circuit study and protective device selective coordination study for both the utility power distribution system and the emergency/standby power distribution system under the scope of this study. The study shall include but shall not be limited to:
 - a. Full compliance with applicable ANSI and IEEE Standards.
 - b. Preformed on nationally recognized computer software such as EDSA, SKM System Analysis, ETAP, or equal.
 - 2. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the CONTRACTOR at no additional cost to the OWNER.

1.3 REFERENCES

- A. Reference Standards: Comply with applicable provisions and recommendations of the latest edition of the following, except where otherwise shown or specified.
 - 1. IEEE 141, Recommended Practice for Electric Power Distribution for Industrial Plants.
 - 2. IEEE 241, Recommended Practice for Electrical Power Systems in Commercial Buildings.
 - 3. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 4. IEEE 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - 5. IEEE 519- Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - 6. IEEE 1584, Guide for Performing Arc Flash Hazard Calculations.
 - 7. NFPA 70E, Standard for Electrical Safety in the Workplace.
 - 8. ANSI C37.010, Method of Short Circuit Analysis.

- 9. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
- 10. Standard C37.91, IEEE Guide for Protective Relay Applications to Power Transformers.
- 11. Standard C37.95, IEEE Guide for Protective Relaying of Utility-Consumer Interconnections.
- 12. Standard C37.96, IEEE Guide for AC Motor Protection.
- 13. Standard C57.12.59, IEEE Guide for Dry-Type Transformer Through-Fault Current Duration.
- 14. Standard C57.13, IEEE Standard Requirements for Instrumentation Transformers.
- 15. Standard C57.109, IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration.
- 16. NFPA 70, National Electrical Code (NEC).

1.4 SUBMITTALS

- A. Preliminary Technical Memorandum:
 - 1. ANALYSIS FIRM shall provide a preliminary submittal for review and a technical memorandum in accordance with the study requirements in this specification. This will be submitted for approval by the ENGINEER and OWNER. Submittal shall include:
 - a. Technical Memorandum
 - 1) Review for adequate installation based on available fault current
 - 2) Recommendations for alternate equipment based on system coordination
 - 3) Recommendations for alternate design considerations based on energy levels
 - 4) Report shall include:
 - a) Input Data
 - b) Result tables for each study, including each scenario for utility power, standby power, etc.
 - c) Graphic, color, time-current curves
 - d) One-Line diagram
 - e) CT ration and burden calculations to show that they will not saturate under any fault condition.
 - 2. Preliminary Technical Memorandum shall be submitted and reviewed by the ENGINEER to ensure EDS electrical equipment order being released for manufacturing meets the requirements of the project.
- B. Final Report:
 - 1. ANALYSIS FIRM shall submit a final sealed report upon project substantial completion in accordance with the study requirements in this specification. Final report shall be in PDF format and include all documents as noted below.
 - 2. ANALYSIS FIRM to provide the following documents in the final report:
 - a. Final Report with explanatory text specific to the project.
 - b. All input and calculated data in tabular form.
 - c. Description of all scenarios studied.
 - d. Conclusions and recommendations.
 - e. Overcurrent protective device and relay settings tables.
 - f. Annotated Single Line Diagrams Power Study Management Scenario with available fault currents and voltage drop shown.
 - g. Time Current Curves.
 - h. Arc Flash Labels.

- C. Final Short Circuit and Selective Coordination Study Report shall include but not limited to:
 - 1. The selection of all protective relay types, current transformers, fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary coordination study, which shall be submitted prior to the equipment shop drawings. The complete study shall be approved by the ENGINEER before any equipment is shipped. The report shall include the following sections and information:
 - 2. A technical memorandum Summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, statement of the adequacy of the distribution equipment to safely clear any fault currents, the adequacy of the distribution equipment to close in on a fault, identify any problem areas with provide recommendations for resolving the problem.
 - 3. Electrical distribution system one-line diagram. One-line diagrams shall be legible on printed paper and shall not exceed 11×17 inches in size. Provide multiple pages if necessary.
 - 4. Provide detailed "Input Data" report that identifies all input parameters associated with the equipment depicted on the system one line diagrams including but not limited to Utility data, conductor sizes and lengths, protective device sizes and rating, transformer sizes and ratings, motor types and sizes, etc.
 - 5. Tabulation of all protective devices, circuit breakers, fuses, current transformers, etc. The tabulation shall indicate the device, manufacturer, catalog number, recommended setting, etc.
 - 6. Provide current transformers' ratio and burden calculations to confirm that the current transformers will not saturate prior to operation of the protective relays and to confirm the current transformers used with differential protection will not saturate under any fault condition.
 - 7. Transformer differential protection calculations including current transformer mismatch relay setting and charts. Provide differential current transformer wiring schematics including polarity and wiring connections based on the winding configuration of the actual power transformers being supplied.
 - 8. Graphic time current, protective relay and protective device curves, showing equipment and material damage curves, relay, circuit breaker, fuse curves, available fault currents at the equipment, transformer inrush currents, etc., for each piece of equipment. TCC's shall be produced and printed in color to assist the reviewing ENGINEER in the graphical analysis of the protective device coordination. Each device on a TCC shall be a different color and where devices are shown on multiple TCCs the color for the device shall be constant on each TCC that the devices are shown on.
 - 9. Tabulation of each protective device, its short circuit rating, the available fault current available at the device, and PASS/FAIL indication whether or not the device is adequately rated for the available fault current and voltage at which it is applied.
- D. Preliminary Arc Flash Study Report shall include but not limited to:
 - 1. A technical memorandum Summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.
 - 2. Recommendations to reduce the arc flash incident energy levels
- E. The Final Arc Flash Study report shall include the following sections and information:

- 1. A summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.
- 2. Provide a detailed bus label for each fault location. Each label shall include a listing of the protective device settings and incident energy at several different working distances.
- 3. Provide A NFPA 70 E work permit form for each fault location.
- 4. Provide labels for each fault location.
- 5. PPE Table Provide a PPE table that defines the Personnel Protective Equipment and clothing descriptions identified in the reports and labels for each incident energy range.
- F. Preliminary Harmonic Study Report shall include but not limited to:
 - 1. Electrical distribution system one-line diagram.
 - 2. Provide the minimum available fault current available from the utility and show the calculations of plant load vs. available fault current to determine the appropriate THD threshold as defined in IEEE 519.
 - 3. Provide the harmonic parameters assumed for use in the study for the harmonic generating equipment, i.e., VFD units, UPS units, static inverters, Ozone units, etc.
- G. Final Harmonic Study Report shall include but not limited to:
 - 1. The selection of the harmonic mitigation equipment shall be the responsibility of the manufacturer and shall be based on the preliminary harmonic study, which shall be submitted prior to the equipment shop drawings. The complete study shall be approved by the ENGINEER before any equipment is shipped. The report shall include the following sections and information:
 - a. A summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, document harmonic profile for all harmonic producing equipment.
 - b. Electrical distribution system one-line diagram.
 - c. Recommended parameters for harmonic mitigation equipment, if required. Recommendations shall detail the projected effects of the mitigation effects and shall prove them via a revised harmonic study.
 - d. Calculations and documentation indicated.

1.5 QUALITY ASSURANCE

- A. Analysis Firm's Experience
 - 1. Specialty firm shall have been in the business of the type of work specified, for at least the past five years.
 - 2. The specialty firm shall have a minimum of three projects of equal or greater size, service, with the type of equipment specified for each of the past three years.
- B. All electrical studies shall be stamped and signed by a professional electrical engineer. The ENGINEER shall be registered in the State in which the equipment will finally reside.

PART 2 - PRODUCTS

2.1 POWER SYSTEM / ARC FLASH ANALYSIS FINAL REPORT

A. Professional Certified Report:

- 1. ANALYSIS FIRM shall provide a certified report that shall include but is not limited to:
 - a. An executive summary.
 - b. Methods, assumptions, and procedures used in the analysis.
 - c. Findings and recommendations requiring actions not within the ANALYSIS FIRM scope of work.
 - d. Electrical Distribution System Overview as illustrated on the CONTRACT DOCUMENTS.
 - e. Appendices with the SKM documents of the equipment data used in the analysis and the analysis results.
- 2. Report shall be reviewed and sealed by a professional engineer registered in the state of Utah
- B. SKM Single-Line Diagram(s):
 - 1. SKM Single-Line Diagram(s) legible on 11 x 17-inch sheet size, landscape view. Include the following information:
 - a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
 - b. Type designation, current rating, range or adjustment, manufacturer's style or type for all protective devices.
 - c. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
 - d. Type, manufacturer, and ratio of all current transformers energizing each relay.
 - e. Manufacturer's nameplate data of all motors and generators.
 - f. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.
 - g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.
 - h. Normal switching conditions where possible.
 - i. The final settings of adjustable breakers, relays and direct-acting trips.
- C. Short Circuit Study:
 - 1. The short circuit analysis shall be performed in accordance with ANSI Standards C37.010 and C37.13 to determine the adequacy of circuit breakers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents. Short circuit momentary duties and interrupting duties shall be calculated on the basis of worst case scenario / maximum available fault current at the switchgear busses and motor control centers.
 - 2. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly addressed in the analysis. The analysis shall assume all motors operating at rated voltage. Redundant/standby motors shall be excluded where known system limitations prevent simultaneous operation. Electrical equipment bus impedance shall be assumed zero (SKM default setting).
 - 3. The study shall address the case when the system is being powered from the utility source as well as from the on-site generating facilities, normal and alternate (bus tie closed) modes of operation. Minimum and maximum possible fault conditions shall be covered in the study. It shall be the responsibility of the CONTRACTOR performing the study to determine the operating parameters of the system and to derive the worst-case fault conditions.

- 4. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.
- 5. Calculate short-circuit momentary duties and interrupting duties on the basis of an assumed bolted 3 phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. The short circuit tabulations shall include X/R ratios, asymmetry factors, KVA and symmetrical fault-current. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.
- 6. Provide the following:
 - a. The available fault current at each bus within the limits of the study shall be identified and listed.
 - b. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated
 - c. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. The results shall be tabulated in the form of a PASS/FAIL device evaluation table Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the ENGINEER.
 - d. The short circuit portion of the report shall include:
 - Summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identify any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
 - 2) Input data.
 - 3) Three phase and ground fault studies. Indicate the fault current available at each major equipment, distribution bus within the high, medium and low voltage distribution systems.
 - 4) Table listing all the electrical distribution and utilization equipment (including VFDs), the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
 - 5) The short circuit study shall be prepared using approved computer software and must include complete fault calculations as specified herein for each proposed and ultimate source combination. Source combinations may include present and future Power Company supply circuits, large motors, or generators.
- 7. Automatic Load Transfer
 - a. Provide a detailed study demonstrating the interrupting capacity of automatic transfer bus ties and switches, as well as the fault withstand capabilities. The following shall be considered:
 - 1) X/R ratio fault-current of circuit at point of transfer.
 - 2) X/R ratio and fault-current rating of the transfer device.
 - 3) Length of time fault may persist prior to protective device opening.

- 4) Magnetic stress withstand rating.
- 5) I2t withstand rating.
- 6) Transfer device maximum interrupting duty compared to load interrupting duty.
- D. Protective Device Coordination Study:
 - 1. The protective device coordination analysis shall be performed in accordance with ANSI/IEEE Std. 242 to determine the required settings/sizes of the protective devices to maximize selectivity. The phase over-current and ground-fault protection settings shall be included as well as settings for all other adjustable protective devices, excluding vendor supplied packaged equipment. Areas lacking complete coordination shall be identified and justification provided for allowing condition to remain or the ENGINEER shall provide solution to resolve situation.
 - SKM Time-Current Curve(s) legible on 11 x 17-inch sheet size, landscape view on 10- cycle, green log-log graph paper. Include the following information for each time-current curve:
 - a. Protective device, relay, or fuse showing graphically that the settings provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified.
 - b. Each device shall be positioned to provide maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the ENGINEER shall be notified as to the cause.
 - c. Points for cable and equipment damage.
 - d. Circuit interrupting device operating and interrupting times based on the amperage.
 - e. A SKM Single line sketch of bus and breaker arrangement for each time-current curve.
 - 3. Provide breaker setting table with sign off form for CONTRACTOR'S use during implementation of breaker settings.
 - 4. Provide coordination plots of protective devices plus tabulated data, including ratings and settings selected. In the study, balance shall be achieved between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.
 - 5. Provide separate plots for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system; (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Show maximum and minimum fault values in each case. Multiple power sources shown in one plot is not acceptable.
 - 6. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults. Separate the protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity. The protective device characteristics or operating bands shall be terminated to reflect the actual symmetrical and asymmetrical fault-currents sensed by the device. Provide the coordination plots for

3 phase and phase-to-ground faults on a system basis. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in-each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

- 7. Select relay types (i.e., inverse, very inverse, extremely inverse, over current with or without voltage restraint, timers, etc.), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc., that will allow the system to be protected to within the equipment fault ratings and provide the maximum possible coordination between the protective devices.
- 8. Multifunction Solid State Relays
 - a. Where multifunction solid state relays are already installed, it shall be the responsibility of the CONTRACTOR to obtain the current and complete list of software setpoints programmed into the device. These setpoints shall be evaluated for potential impacts on the protective device coordination.
 - b. Where multifunction solid state relays are being install, it shall be the responsibility of the CONTRACTOR to provide all setpoints needed for the specified operation of the relay. These settings include but are not limited to:
 - The complete pickup settings of all protective elements specified by the designer and shall not be limited to only the overcurrent pickup settings. Settings for protective elements such as reverse power, synchronization, frequency and voltage control, etc. shall be provided in full.
 - 2) Differential pickup and zone settings necessary for the relay to operate as specified and designed and to protect the zone it is intended for. Zone of protection calculations and balance equations shall be completed entirely by the CONTRACTOR based on the equipment as furnished and designed.
 - 3) The complete protective relay logic map and logic equations. The relay logic is responsible for translating the pickups of the protective elements into relay output events and device trips. All logic necessary to create the specified output of the relay based on the specified protective elements shall be furnished with the protective device coordination report.
 - 4) Any and all miscellaneous settings necessary for the relay to communicate with the installation systems and the mirroring of data to other installation systems as specified or designed.
 - c. CONTRACTOR shall be responsible for the programming of relays prior to the field testing and start up requirements of this contract. The CONTRACTOR shall be responsible for all time needed to complete the relay settings in order to furnish a completely functional system as specified and required by the approved protection device settings.
- 9. Arc Flash Mitigation and Reduction Modes
 - a. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the CONTRACTOR shall coordinate these alternative pickup settings and provide representation of their tripping characteristics via TCC's. The alternative pickup settings shall be coordinate with the associated load and shall be set to provide the fastest device response time while avoiding nuisance trips during normal plant operation.
- 10. Generator Protective Devices
 - a. The study shall address all of the protective devices provided for generator protection.
 - b. Protective relays requiring settings shall be included.
 - c. The Electrical Contractor shall obtain all necessary generator information to perform this study.
- 11. Motor Protection and Coordination

- a. Provide a complete and independent set of current-time characteristic curves for all motors 50 HP and above indicating coordination between the protective relays and the thermal and starting characteristics of the motor.
- b. The CONTRACTOR shall obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100% Voltage" and "Accelerating Time vs. Current at 100% Voltage" are necessary and shall become part of the final report.
- 12. Call discrepancies to the attention of the ENGINEER in the conclusions and recommendations of the report.
- 13. The Time current Characteristic Curves shall include:
 - a. The coordination plots shall graphically indicate the coordination proposed for the several systems centered on full-scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated upstream power system relays, fuse or system characteristics, significant motor starting characteristics, significant generator characteristics, complete parameters for power, and substation transformers, complete operating bands for low voltage circuit breaker trip devices, fuses, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required. The short-time region shall indicate the relay instantaneous elements, the magnetizing inrush, and ANSI transformer damage curves, the low voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault-currents.
 - b. No more than six devices shall be shown on one coordination plot. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots in order to provide cross-reference. Give each curve in the study a study-unique number or letter identifier to permit cross-reference between plots.
 - c. The coordinating time interval between primary and back-up protective devices shall be as per Table 15-3, Section 15.6, IEEE Std. 242-2001.
 - d. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings. A tabulation shall include settings for every overcurrent protective device, timer, power system relays (e.g., ANSI 25, 27, 32, 67, 87, etc.), circuit breaker, recommended fuse and current transformer ratings, etc. Include C.T. ratio, burden and all other calculations required for the determination of settings. Provide recommended settings for all protective devices furnished under Division 26, Electrical and furnished with those furnished with Variable Frequency Drives and associated transformers, generators and associated paralleling and distribution switchgear.
- E. Arc Flash/Shock Hazard Analysis:
 - 1. The arc flash / shock hazard analysis shall be conducted in accordance with the methods outlined in IEEE Standard 1584 and stated hereinafter. Work shall be in accordance with NFPA 70E which includes the fabrication of labels with the arc flash / shock incident analysis results, OWNER's personnel protective equipment (PPE) risk level, the energy available, clothing recommendation, equipment name, ANALYSIS FIRM contact information, and date analysis was performed.
 - 2. The analysis shall include the following IEEE 1584 analysis process:
 - a. Collect system and installation data.

- b. Determine modes of operation.
- c. Determine bolted fault current.
- d. Determine arc fault current.
- e. Determine protective device characteristic and arc fault duration.
- f. Document system voltages
- g. Select working distances.
- h. Calculate incident energy.
- i. Calculate the arc flash protection boundary.
- 3. Provide a copy of each installed Equipment Specific label on $8\frac{1}{2} \times 11$ -inch sheet size, portrait view in actual size and color printed and installed on the equipment.
- 4. Provide an arc flash study that utilizes the fault current values calculated in the short circuit study and the minimum clear times of the upstream protective device selected in the coordination study to calculate the incident energy at each fault location.
- 5. Calculate the incident energy levels at each faulted bus for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system; (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Determine arc flash incident energy values for both maximum and minimum fault values in each case.
- 6. Extent of Study
 - a. The arc flash study shall include analysis for all equipment that would normally be serviced while energized and cannot be easily shut down during maintenance periods. The CONTRACTOR shall coordinate with the OWNER to ensure that all equipment that is expected to be analyzed is included in the study. The extent of the analysis includes but is not limited to:
 - 1) Switchgear, MCC's and distribution equipment
 - 2) Low voltage lighting panels, even those covered by certain calculation exceptions must be modeled and provided with a unique device label
 - 3) Low voltage control equipment such as 120-600 V control panels.
- 7. Arc Flash Labels
 - a. The arc flash study shall produce a single set of label templates that shall not be printed until the final arc flash study has been approved.
 - b. A single set of labels shall be printed and affixed to the equipment analyzed if the equipment is continuous. Double ended equipment shall have individual labels for each side of the gear. Equipment that is not continuous shall have a single label placed on each piece of continuous gear.
 - c. Where applicable, LINE and LOAD labels shall be produced for equipment. Examples of equipment that require these labels include the main breakers of switchgear and MCC's. In these cases, the LINE side breakers shall be affixed to indicate the hazard associated with the line side of the equipment and the LOAD label shall be affixed to indicate the hazard associated with the rest of the gear.
 - d. Labels shall be affixed where they are clearly identifiable with the equipment they depict. Labels shall not obscure any other signage on the equipment unless they are used to completely cover a previous arc flash label.

- e. Labels shall meet the following requirements:
 - Labels shall be indoor/outdoor rated weather resistant vinyl or polyester with a UV resistant overlaminate. The label shall have a minimum thickness of 5 mil. Labels shall be backed with pressure sensitive permanent cold

temperature adhesive rated for a minimum 5 year life in the environment in which they are installed.

- 2) All lettering shall be black and printed via thermal transfer. Backgrounds shall be orange for hazard risk categories 1-4 and red for "Dangerous" areas.
- 3) Where subjected to degrading or corrosive environments, the labels shall be provided with a tinted fiber glass cover.
- 4) The label shall match any pre-existing facility or client specified formatting. The CONTRACTOR shall be responsible for obtaining this formatting information prior to submitting label templates.
- 5) A single label for equipment is acceptable where equipment is continuous. In the event of split busses or equipment not arranged in a continuous fashion, multiple labels shall be provided.
- 6) Line side labels for equipment main breakers shall be included in addition to load side labels.
- 7) Labels shall be DANGER/WARNING type conforming to the NFPA 70E and ANSI Z534.4 standards. Labels are required to have the minimum information specified by these standards printed on them. Labels shall be legible and standard throughout the plant.
- 8) Labels templates shall be provided to the ENGINEER and client for final approval and shall be printed and affixed by the CONTRACTOR. CONTRACTOR shall be responsible for all work required to print and affix the labels to the equipment. Labels shall be affixed in accordance with the direction of the client.
- f. CONTRACTOR shall produce all arc flash labels and coordinate affixing them onto all equipment.
- 8. Arc Flash Mitigation and Reduction Devices
 - a. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the CONTRACTOR shall provide an alternative arc flash lookup table associated with these alternative settings.
 - b. Labels shall have only the worst case hazard risk category (without the arc flash reduction settings) depicted. Multiple labels for different device settings shall not be accepted.
 - c. Devices such as differential protection relays which limit incident energy by limiting the magnitude of the available fault and/or minimizing the fault clearing time may be used to calculate hazard risk categories. The use of these devices in the calculations shall only be permitted where permitted by the standards and code guidelines used to complete the arc flash analysis. If not explicitly stated by the standard as an acceptable method for calculating arc flash hazard, it shall not be permitted.
- 9. Arc Flash Hazard Mitigation
 - a. Acceptable hazard risk categories shall be coordinated by the CONTRACTOR between the OWNER and ENGINEER. Where there are no guidelines determining acceptable arc flash levels, the CONTRACTOR shall actively attempt to reduce all hazard risk categories greater than 2. CONTRACTOR shall list all areas greater that category 2 in the conclusion of the report and shall give reasons for the high incident energy.
 - b. The CONTRACTOR shall be responsible for proposing and evaluating arc flash mitigation measure including but not limited to:
 - 1) Adjustment of protective devices in an attempt to better balance the system coordination and the incident energy available to an arcing fault.
 - 2) Equipment that could be used to physically remove the operator from the arc flash hazard boundary (mimic panels, remote switching/racking).

- 3) Equipment that could be used to limit the amount of incident energy or reduce the protective device pickup time (maintenance mode bypass, differential relaying).
- c. Proposing an evaluating these arc flash mitigation measures shall include evaluating the cost and implementation of the options as well as reevaluating and reporting the hazard risk category associated with their installation.
- F. HARMONIC STUDY
 - 1. Provide a harmonic study for all harmonic producing equipment to determine the harmonic currents and voltages of the electrical distribution system.
 - 2. The harmonic study shall provide a harmonic current and voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, each switchgear/switchboard and motor control center bus.
 - 3. A complete Harmonic current and voltage profile shall be provided for the minimum anticipated fault current available from the utility and the standby generator for each of the following operating conditions:
 - a. All tie circuit breakers open with electrical distribution system operating doubleended.
 - b. One profile for all equipment running (Full speed condition for VFD units)
 - c. One profile for all equipment running (70% of full speed condition for VFD units).
 - d. All tie circuit breakers closed with the electrical distribution system operating single-ended.
 - 1) One profile for all equipment running (Full speed condition for VFD units)
 - 2) One profile for all equipment running (70% of full speed condition for VFD units).
 - 4. The CONTRACTOR shall obtain from the harmonic generating equipment suppliers the necessary information to perform the study. Certified harmonic information is absolutely necessary and shall become part of the final report.
 - 5. The harmonic study shall contain, as a minimum, the following:
 - a. Explanation of method used to perform the study.
 - b. Explanation of study results with specific recommendations on filters and/or other measures that will be implemented to meet the specified limits.
 - c. All calculations and/or computer printouts used to arrive at the recommendations.
 - d. Individual drive voltage and current harmonic content up to the fiftieth harmonic, and the combined total of all the drive harmonic contents reflected in the system source supply voltage and current as a percent of the 60 Hz fundamental under actual load conditions from 0 to 60 Hz at 10 Hz increments.
 - 6. If the harmonic distortion for voltage and current distortion levels and line notching do not meet the requirements of IEEE 519. The CONTRACTOR shall specify the appropriate filter traps that provide the filtering required to meet the requirements of IEEE 519 as specified herein.
 - 7. The manufacturer shall be responsible to provide all data necessary to perform the study. This includes nonlinear load producing equipment signature, feeder cable sizes, approximate feeder length, motor data, switchgear data, utility data, alternate source data, existing field data (if required) and any other information relevant to the study.

2.2 LABELS

A. Arc Flash Potential Labels:

- 1. Category Label:
 - a. A standard Arc Flash Warning label shall be installed on all equipment with a Category 1 or 2 with available fault current less than 25kAIC. All other components must have an equipment specific label generated from SKM using calculated values as described in 2.2.A.2.
 - b. Provide a 2 $1/2 \times 3 1/2$ -inch label format with coloring to match one of the labels shown on Figure 2.2.B.1 below.



Figure 2.2.B.1

- 2. Calculated Specific Equipment Labels:
 - a. Arc Flash Potential Warning labels shall be installed on all equipment with a calculated energy level.
 - b. Provide standard 4 x 5-inch rectangular labels.
 - c. Provide a label format with coloring to match Figure 2.2.B.2 below.



94 in 18 cal/cm^2	Flash Hazard Boundary Flash Hazard at 18 Inches Minimum Rating of 25 cal/sq
Level 3	cm Cotton Underwear + AR Shirt & Pants or AR Arc Flash Suit + AR Flash Hood
42 Inches	Limited Approach
12 Inches	Restricted Approach
EQUIPMENT:	SES LOAD SIDE MAIN
SKM SLD:	001 1 Line-UH-All
	ABC Electrical
Contact	ABC Electrical (123) 456-7890
Contact Info:	ABC Electrical (123) 456-7890
Contact Info: Date:	ABC Electrical (123) 456-7890 01/01/2000

Figure 2.2.B.2

- 3. Label Material:
 - a. Label shall be an indoor/outdoor high performance, pressure sensitive safety sign.
 - b. Materials shall be UV rated surface printed polyester with polyester overlaminate. Labels shall be abrasion, chemical and heat resistant (-40 to 110 degrees C (-40 to 230 degrees F)), with an average outdoor durability of five to eight years.
 - c. Product Manufacture: Provide the following:
 - 1) Printer and Label Materials
 - a) BRADY Powermark Printer, BRADY Label Part# 13651
 - b) Or Equal

PART 3 - EXECUTION

3.1 GENERAL

- A. ANALYSIS FIRM shall inspect all installed equipment for conformance with the fully executed POWER SYSTEM / ARC FLASH ANALYSIS. Any deviations found shall immediately be brought to the OWNER and ENGINEER'S attention.
- 3.2 BREAKER SETTINGS
 - A. The CONTRACTOR shall coordinate with the ANALYSIS FIRM to implement the breaker settings defined in the approved preliminary report submittal.
 - B. The ANALYSIS FIRM shall inspect all breaker settings implemented in the field by the CONTRACTOR. If the recommended breaker setting(s) are adjusted, the ANALYSIS

FIRM will update the final report with the actual settings. CONTRACTOR or ENGINEER is to provide written justification for any deviations.

3.3 BREAKER TESTING

A. The CONTRACTOR shall coordinate the final settings of the breakers during the startup and functional testing of the process systems EDS. If the breaker settings require adjustment, the CONTRACTOR will coordinate with the ENGINEER and ANALYSIS FIRM to update the Power System Arc Flash Analysis Report with the final settings.

3.4 LABELING

- A. All Service Entrance Sections (SES), switchboards, switchgear, Motor Control Centers (MCC), transformers, distribution boards, panel boards, disconnects and control panels shall have both an arc flash label and voltage label. ANALYSIS FIRM shall determine the proper arc flash label.
 - 1. Install all labels level and in an upright position. Do not cut or alter in any way. Install label in a professional manner. Clean surface as needed to allow for good adhesion.
 - 2. Labels shall not be installed atop any manufacturer name plate data or equipment tag labels.
 - 3. Where equipment does not have sufficient space for an Arc Flash Label the CONTRACTOR shall furnish a fabricated mounting plate constructed of stainless steel sheet metal per direction from the ENGINEER. Mounting plate shall be affixed to the equipment using stainless steel screws. Installation shall maintain the equipment NEMA rating of the equipment. Mounting plate shall not interfere with equipment operation and shall be readily visible.
 - 4. In the case of more than one source of power to a piece of equipment, the highest voltage label shall be applied, and an additional label shall be applied indicating more than one source of power located inside the equipment.
 - 5. For outdoor switchgear, place a single Arc Flash label on the outside of the access door nearest to the main breaker, and one inside on the respective breaker enclosure. All other Arc Flash labels shall be placed inside the access doors on the respective breaker enclosure or cover. If there are back access panels to the equipment, the arc flash labels placed at the front of the gear shall be duplicated and placed on the back access panels at the same relative location.
 - 6. For disconnect switches, panel boards, distribution boards, load centers, and control cabinets, the labels should be applied in plain view on the front cover.

++ END OF SECTION ++

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SECTION 26 12 19

PAD-MOUNTED TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide the labor, materials, equipment, incidentals required to furnish and install pad-mounted transformers 150 KVA and larger with copper windings, complete and operational, as specified and shown on the Drawings.
 - 2. Transformers shall be coordinated with Provo Power and must meet Provo Power specifications in addition to the specifications below.
 - 3. Provide anchorage and support design, including seismic, for pad-mounted transformers in accordance with General Electrical Provisions under Division 26.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
 - 1. NEMA TR1, Transformers, Regulators and Reactors.
 - 2. ANSI C57.12, General Requirements for Distribution, Power, and Regulating Transformers.
 - 3. ANSI C57.93, Guide for the Installation and Maintenance of Oil-Immersed Transformers.
 - 4. National Electrical Code (NEC) current adoption.
 - 5. IEEE, Institute of Electrical and Electronic Engineers.
 - 6. ASTM, American Society of Testing and Materials.
 - 7. UL, Underwriter's Laboratories.
- B. Factory test prior to shipment in accordance with ANSI Test Code C57.12.00/C57.12.90. Furnish test results to ENGINEER. Tests shall include:
 - 1. Polarity check
 - 2. Ratio check
 - 3. No-load loss
 - 4. Exciting current at rated voltage
 - 5. Load loss
 - 6. Impedance
 - 7. Production line impulse test
 - 8. Dielectric tests at low frequency
 - 9. Mechanical leak test
- C. UL listed and labeled.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for pad-mounted transformers proposed for use, including pad layout with all dimensions, weight, ratings, and accessories identified.
 - 2. Support hardware information.

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- 3. Drawings:
 - a. Plan and elevation.
 - b. Anchoring details.
 - c. Bushing details.
 - d. Conduit Entrance openings.
 - e. Wiring Details
 - f. Nameplate.
- 4. Reports of transformer factory tests.
- B. Operation and Maintenance Manual.
 - 1. Instruction, operating and maintenance manual covering all equipment furnished in accordance with the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rating:
 - 1. Ratings as indicated on the drawings.
 - 2. Coolant: Mineral Oil.
 - 3. Temperature Rise: 65 degrees C (149 degrees F).
 - 4. Taps: Full capacity, two 2 1/2 percent primary taps above normal and two 2 1/2 percent primary taps below normal.
 - 5. Impedance: 5 3/4 percent.
- B. Construction:
 - 1. Dead-front construction.
 - 2. Compartmental-type unit consisting of transformer tank with high and low-voltage cable terminating compartment, assembled as an integral unit for mounting on a pad.
 - 3. Externally clamped high voltage epoxy bushing wells for 200 A load-break, or 600 A non-load-break inserts. Steel barrier separating low-voltage compartment.
 - 4. Low-voltage compartment with bushings and NEMA spade terminals and ground lug. Provide link to solidly ground X0 terminal to ground lug.
 - 5. Tamper proof design with no exposed screws, bolts or other fastening devices which are externally removable and no openings through which foreign objects might contact live parts.
 - 6. Full-height, incoming and outgoing terminal compartments with hinged doors and steel barrier between compartments:
 - a. Compartment doors equipped for latching in the open position and capable of being secured with a single padlock.
 - b. Door hardware and hinge assemblies made of corrosion-resistant material.
 - 7. Lifting, jacking and rolling provisions.
 - 8. Manufacturer's Instruction Nameplate: A factory installed stainless steel plate and screws permanently affixed to a non-removable part in the low-voltage compartment and located so that it is readable with cables in place.
 - 9. Transformer Tank: Sealed tank construction with welded main cover and bolted tamper-resistant handhole for access to internal connections.
 - 10. Tank grounding provisions in high- and low-voltage compartments.
 - 11. Low-voltage Bushings: Tinned, spade type.
 - 12. High-voltage Bushings: Porcelain, live-front arrangement.

- 13. High-voltage Entrance: Three, cast resin bushings with phase barriers between bushings.
- 14. Terminals arranged for cabling from below.
- 15. Identification: Identify transformers in accordance with Section 26 00 00, General Electrical Provisions, identifying the transformer identification number, primary and secondary power identification and voltage.
- C. Accessories:
 - 1. Lightning arrester mounting pads with three lightning and surge over voltage arrestors.
 - 2. Gang-operated internal oil-immersed load break switch with bayonet primary expulsion fuses. Furnish with Bayonet dual sensing fusing device and fuses capable of breaking transformer full load current and provided with oil drip shield.
 - 3. Where drawings require loop feed, furnish 2 (2) two-position under-oil gang-operated switches to be used for sectionalizing and loop feed connections.
 - 4. Fill plug and automatic pressure relief device.
 - 5. Drain valve and sampler.
 - 6. Manually operated de-energized tap changer with handle.
 - 7. Liquid-level gage with alarm contacts.
 - 8. Vacuum-pressure gage with alarm contacts where shown on the drawings.
 - 9. Dial-type thermometer with alarm contact.
 - 10. A NEMA 4 control cabinet with all switch contacts wired to terminal blocks. Provision for padlocking.
 - 11. Oil required to place transformer into service.
- D. Sound Level
 - 1. The transformer and auxiliary cooling equipment shall be designed and constructed to minimize the audible noise generated with the transformer energized at rated voltage and with all auxiliary cooling equipment in operation. The acceptable noise level shall be in accordance with NEMA standard TR 1.
- E. Nameplates
 - 1. Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware. The diagrammatic nameplate shall include the name of the manufacturer of the equipment as well as the location where the transformer was manufactured and tested. In addition, the nameplate shall contain all connection and rating information ANSI.
- F. Finish
 - 1. The transformer shall be thoroughly cleaned and phosphortized, paint with at least one corrosion inhibiting primer and one finish coat to provide a minimum total dryfilm thickness of not less than 3 mils. All surfaces shall be clean and smooth, clear of burrs and blemishes, all external welds ground smooth and all sharp corners eliminated before any rust proofing or paint is applied. Finish shall be ANSI 61.
- G. Transformer Testing: The following factory tests shall be performed in accordance with the latest revision of ANSI Standard Test Code for Transformers, C57.12.90 and C57.12.91.
 - 1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating.
 - 2. Ratio tests on the rated voltage connection and on all tap connections.
 - 3. Polarity and phase-relation tests on the rated voltage connection.

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- 4. No-load loss at rated voltage on the rated voltage connection.
- 5. Exciting current at rated voltage on the rated voltage connection.
- 6. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating.
- 7. Temperature Test: Tests shall be made only when there is not available a record of a temperature test made in accordance with ANSI Standards on a duplicate or essentially duplicate unit. Tests, when made, shall be made under conditions specified in American Standards for Transformers and on one unit only of a given rating.
- 8. Applied potential tests.
- 9. Induced potential tests.
- H. Product and Manufacturer: Provide one of the following:
 - 1. Maddox
 - 2. Square D
 - 3. General Electric Company.
 - 4. ABB.
 - 5. Siemens.
 - 6. Or engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance. Working space at least 10 feet in front of mediumvoltage compartment access and 3 feet around other sides. Clearance from structures shall be in accordance with code requirements and Rocky Mountain Power (RMP) manual 2016, 4th edition, paragraph 4.6, Figure 9.
- B. Install transformer on concrete pad vault per Provo Power details.
- C. Set taps for proper voltage at service distribution equipment.
- D. Unless otherwise shown on the Drawings, install ground rod directly beneath transformer. Connect grounding electrode conductor(s) to ground rod. Where transformers are to be mounted on existing concrete slabs, drill slab for ground rod penetration. Connect to underground grounding loop.

++ END OF SECTION ++

SECTION 26 13 13

MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install an indoor, free-standing metal-clad, medium-voltage switchgear lineup complete and operational with separate neutral grounding resistor. The metal-clad switchgear assembly shall consist of deadfront vertical sections.
- B. The manufacturer of the medium-voltage switchgear shall also be the manufacturer of all major components therein.
- C. Provide anchorage and support design, including seismic, for medium-voltage switchgear in accordance with General Electrical Provisions under Division 26.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.
 - 1. ANSI C37.010, Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 2. ANSI C37.04, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 3. ANSI C37.06, Switchgear-AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 4. ANSI C37.09, Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 5. ANSI C37.11, Power circuit breaker control.
 - 6. ANSI C37.20.2, Metal-clad and Station-Cubicle Switchgear.
 - 7. ANSI C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - 8. ANSI C37.100, Definitions for Power Switchgear.
 - 9. ANSI C57.13, Instrument Transformers, Standards for.
 - 10. NEMA SG-2, High Voltage Fuses.
 - 11. NEMA SG-4, Alternating Current High Voltage Power Circuit Breakers.
 - 12. NEMA SG-5, Power Switchgear Assemblies.
 - 13. UL, Underwriters Laboratories.
- C. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

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1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Submit for approval, to both the ENGINEER and OWNER, copies of manufacturer's technical information for equipment proposed for use. Submittals shall include the following:
 - a. Dimensional information.
 - b. One-line diagrams.
 - c. Technical specifications.
 - d. Catalog cuts with supplied options and accessories clearly identified.
 - e. Construction details of enclosure.
 - f. Schematic control diagrams for breaker control and all other controls.
- B. Certification of Ratings: Submit for approval copies of certifications as follows:
 - 1. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type to be furnished under this Section. Certified test abstracts establishing such ratings shall be furnished.
- C. Approval of the switchgear submittal will be contingent upon prior approval of the preliminary power system studies.
- D. Operation and Maintenance Data:
 - 1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of the Work.
- B. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the site. Notify ENGINEER of any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.
- C. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.
- D. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.
- E. Switchgear shall be equipped to be handled by crane. Where cranes are not available switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.
- F. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition.

PART 2 - PRODUCTS

2.1 RATINGS

- A. The medium-voltage distribution system will be low resistance grounded wye.
- B. The ratings for the integrated switchgear assembly shall be as shown on the drawings.

2.2 MATERIALS

A. General:

- 1. The metal-clad switchgear assembly shall consist of multiple, self-supporting bays. The sections shall contain drawout vacuum circuit breakers and controls as shown on the Drawings.
- B. Construction:
 - 1. The switchgear shall consist of a stationary structure constructed from individual vertical sections as shown on the Drawings. The vertical sections shall be bolted together to form a rigid metal-clad switchgear assembly. Metal sheets shall provide grounded metal barriers between adjacent sections.
 - 2. Each breaker compartment shall be equipped to house a removable breaker element. The breaker levering mechanism shall be cell mounted. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. Rails shall allow the withdrawal of each circuit breaker for inspection and maintenance without the use of a separate lifting device. Breaker can be moved to disconnected position within the enclosure. Lift truck shall be required to move the breaker out of the cubicle for maintenance.
 - 3. Power bus shall be tin-plated copper. Bare copper, neutral bus. Ground bus shall be full length, copper. All of the main bus shall have porcelain insulators to ground. This shall include porcelain inserts in the bus support barriers, porcelain standoff insulators and porcelain sleeves for the stationary primary disconnects.
 - 4. All power terminations shall be single conductor potheads for single conductor, copper conductors.
 - 5. The main bus shall have epoxy flame-retardant, track-resistant insulation. Bus supports between units shall be flame-retardant, track-resistant, glass polyester. The bus shall be braced to withstand fault currents equal to the close and latch rating of the circuit breakers contained therein.
 - 6. All sections indicated as "SPACE" on the Drawings shall be provided with all necessary provisions for a future circuit breaker. All PTs, CTs, relays, etc. shall be provided ready for insertion of a circuit breaker.
 - 7. Where shown on the Drawings, provide an additional vertical section which shall include bus taps. Provide bus lugs for the termination of 3-500 KCMIL conductors per phase.
- C. Circuit Breakers:
 - 1. Each circuit breaker shall be horizontal, draw-out type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged spring stored energy mechanism. The spring may be charged manually in an emergency or during maintenance procedures.
 - 2. Each circuit breaker shall have three vacuum interrupter assemblies that are separately mounted on glass polyester insulators. Each vacuum interrupter assembly shall have a

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contact wear indicator which does not require any tools to indicate the

contact wear. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The circuit breaker shall not utilize air or oil dash pots for minimizing vacuum interrupter contact "bounce," upon opening.

- 3. Each circuit breaker shall meet the requirements of ANSI Standards, C37.010, C37.04, C37.06, C37.07, C37.09, C37.11, and C37.100, and shall be as shown on the drawings.
- 4. Each breaker shall have the number of status (52a and 52b) contacts as required by the Drawings and four mechanism cell switches (switches close when circuit breaker is in the "TEST" or "WITHDRAWN" position).
- 5. The breakers shall be electrically operated by 120 volt AC control power. The control power shall be derived from CPTs provided by switchgear manufacturer.
- 6. The two main circuit breakers and the bus tie circuit breaker shall be electrically and mechanically interlocked in order to prevent not more than two of these breakers from being closed at any one time.
- D. Remote Racking
 - 1. Provide a Remote Racking Device to allow remote insertion and removal of a circuit breaker from its cradle and racking between the disconnected position and the connected position. Operation capable of being performed from outside the arc flash zone as described by NFPA 70E/CSA Z462.
- E. Surge Arresters: 8.4 KV intermediate class surge arresters shall be provided and connected at the incoming terminations for each line and securely grounded to the metal structure.
- F. Protective Relaying (Main breakers):
 - 1. Each 15 KV circuit breaker shall be provided with a microprocessor based, front-panel mounted overcurrent trip device which shall operate from 120 volt AC control power. The device shall sense true RMS current in each phase and ground. The ground element shall be capable of either residual or zero sequence ground fault detection or deactivation.
 - 2. The unit shall provide the following protective functions:
 - a. Phase/ground/neutral time and instantaneous overcurrent.
 - b. Negative sequence time overcurrent.
 - c. Undervoltage and overvoltage.
 - d. Breaker failure.
 - e. Manual close control.
 - f. Neutral (3Io) time overcurrent.
 - g. Percent and instantaneous transformer differential protection.
 - h. Volts per hertz.
 - i. Overfrequency.
 - j. Underfrequency.
 - 3. The unit shall have the following additional features:
 - a. Display of individual phase currents, ground current, magnitude and phase of trip current, peak current for each phase and ground since last reset, and CT ratio.
 - b. Total harmonic distortion.
 - c. Adjustable CT ratio.
 - d. Separate time-overcurrent (ANSI 51) and instantaneous (ANSI 50) trip contacts.
 - e. Unit failure alarm contact.
 - f. Trip alarm contact.
 - g. Programmable lockout or self reset after trip.

- h. Integral manual testing capability.
- 4. Communications Capability:
 - a. Ethernet Communications.
 - b. Four relay outputs.
 - c. Four digital inputs.
- G. Protective Relaying (Feeder and Tie Breakers):
 - 1. Each circuit breaker shall be provided with a microprocessor based, front-panel mounted overcurrent trip device which shall operate from 120 volt AC control power. The device shall sense true RMS current in each phase and ground. The ground element shall be capable of either residual or zero sequence ground fault detection or deactivation.
 - 2. The unit shall provide the following protective functions:
 - a. Phase/ground/neutral time and instantaneous overcurrent.
 - b. Breaker failure.
 - c. Manual close control.
 - 3. The unit shall have the following additional features:
 - a. Display of individual phase currents, ground current, magnitude and phase of trip current, peak current for each phase and ground since last reset, and CT ratio.
 - b. Adjustable CT ratio.
 - c. Separate time-overcurrent (ANSI 51) and instantaneous (ANSI 50) trip contacts.
 - d. Unit failure alarm contact.
 - e. Trip alarm contact.
 - f. Programmable lockout or self reset after trip.
 - g. Integral manual testing capability.
 - h. Zone-selective interlocking capability for short time and ground fault protection.
 - 4. Communications Capability:
 - a. Ethernet Communications.
 - b. Four relay outputs.
 - c. Four digital inputs.
- H. Additional Controls and Equipment:
 - 1. Furnish a programmable logic controller to control the operation of the circuit breakers to facilitate automatic switching to alternate sources upon loss of power in a source. The automatic controls shall ensure an open transition source transfer to prevent any two sources from being connected to the same bus simultaneously. The automatic transfer shall occur upon a source undervoltage, frequency out of range, or loss of phase.
 - 2. Coordinate operation with generator controller.
 - 3. Furnish all necessary wiring and auxiliary devices including current and potential transformers, control power transformers and control relays. Control relay contacts shall be adequately rated for the currents to be switched.
 - 4. Furnish necessary control power transformers, fuses, relays and contactors, etc. for a station power automatic throwover scheme. The automatic throwover controls shall feed an external, 120/240 volt panelboard.
 - 5. Furnish a DC power distribution panel with main breaker and all required branch breakers for serving all DC power loads within switchgear.
 - 6. Furnish a Gateway to translate network communications into Ethernet protocol as shown on the network drawings.
 - 7. Nameplates, plastic, as shown on the drawings.
 - 8. All breakers shall include a manually resettable, lockout (Device No. 86) relay. Relay shall have the quantity and type of contacts as required by the Drawings.

- 9. Metering sections as shown on the drawings shall be provided. Each incoming line shall have a complete metering section built in accordance with all applicable standards and requirements. Doors shall have provisions for padlocking.
- I. Conductors:
 - 1. Small wiring, fuse blocks, and terminal blocks within each vertical section shall be furnished as shown on the Drawings and as required. Each control wire shall be labeled with wire markers. Control wiring shall be Type SIS, No. 14 AWG, minimum. Terminal blocks shall be provided for customer connections to other apparatus.
 - 2. Furnish all internal wiring for controls, DC control power and AC power circuits.
- J. Instrument Transformers:
 - 1. Ring type current transformers shall be furnished as specified, as shown on the Drawings and verified by the Power System Study. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal or higher than ANSI standard requirements. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.
 - 2. Voltage and control power transformers of the quantity and ratings as shown on the Drawings shall be supplied. Voltage transformers and control power transformers shall be mounted in drawout drawers. Rails shall be provided for each drawer to permit easy inspection testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn. Furnish a main secondary circuit breaker for each control power transformer. A mechanical interlock shall be provided which shall require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be opened.
 - 3. Instrument transformers shall have metering accuracies compatible with the relays and microprocessor-based metering equipment.
- K. Metering:
 - 1. Provide a metering device for each incoming main circuit breaker with current and potential transformers as shown on the Drawings.
 - 2. Metering device shall monitor and display the following information:
 - a. Phase amperes (each phase): 0.3 percent accuracy.
 - b. Voltage, phase-to-phase: 0.3 percent accuracy.
 - c. Watts: 0.6 percent accuracy.
 - d. Vars: 0.6 percent accuracy.
 - e. Power factor: 1.0 percent accuracy.
 - f. Frequency: 0.1 Hz.
 - g. Kilowatthours: 6 percent accuracy.
 - h. Kilovarhours: 0.6 percent
 - i. Percent current total harmonic distortion in each phase.
 - j. Percent voltage total harmonic distortion between each phase.
 - 3. The unit shall have the following additional features:
 - a. Trend analysis which shall display minimum and maximum values for each metered parameter with date and time of each occurrence.
 - b. The input range of the device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120.
 - c. Alarm contacts rated five amps at 120 VAC.
 - d. Communications capability via a communications module, if required. Protocol shall be as shown on the drawings.

- 4. Control power shall be drawn from the monitored incoming AC line. The device shall have non-volatile memory and not require battery backup. In the event of a power failure, the device shall retain preset parameters.
- L. Manufacturer's Nameplates:
 - 1. Factory installed engraved manufacturer's nameplates, mounted on the face of the assembly, and shall be furnished for all main, tie and feeder breakers. These nameplates shall be laminated plastic with 3/4-inch minimum, white characters on a black background or match existing, secured with stainless steel screws. These nameplates shall also contain item designation, equipment served breaker frame size and breaker trip rating.
 - 2. All control components within the assembly shall be identified in correspondence to appropriate designations on the manufacturer's wiring diagrams.
- M. Accessories:
 - 1. Maintenance tool for manually charging the breaker closing spring and manually opening the shutter.
 - 2. Lift truck.
 - 3. Manual ground and test device. Furnish for each breaker current rating 1 amp and amp).
 - 4. Levering crank for moving the breaker between "TEST" and "CONNECTED" positions.
 - 5. Test jumper for electrically operating the breaker while out of its compartment.
 - 6. Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails.
 - 7. One set of rail extensions and rail clamps.
 - 8. Any additional devices as required and as shown on the Drawings.
- N. UPS Power Source:
 - 1. Switchgear manufacturer shall provide minimum 90 minutes of uninterruptible power supply for all protective relaying, controls, and metering.
 - 2. Provide a continuous-duty, on-line, solid state, dual conversion, single-phase input (using input voltage from the switchgear), single-phase 120VAC true sinewave output uninterruptible power system.
 - 3. The UPS system shall consist of the following major components:
 - a. Rectifier and battery charger.
 - b. Inverter.
 - c. Batteries and battery disconnect switch.
 - d. Automatic static bypass switch.
 - e. External maintenance bypass switch.
 - f. Integral control and monitoring panel.
- O. Infrared Window or Thermal sensor:
 - 1. Provide one of the following where applicable:
 - a. Provide infrared windows for viewing of the line and load side terminals of the main breaker(s).
 - 1) Size: 4 inches
 - 2) Window to be provided with a coating to seal the optic prior to assembly to protect against degradation.
 - 3) Window to be provided with hand turn door latch with identification plate.

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- 4) Mount window with high temperature silicon gaskets.
- 5) Product and Manufacturer: Provide the following:
 - a) Fluke ClirVu® CV Series

- b) Or engineer approved equal
- 2. Thermal sensors:
 - a. Provide thermal sensors with remote display.
 - b. Units shall not require batteries.
 - c. Units shall be capable of remote monitoring without opening the switchgear doors.
- P. Neutral Grounding Resistor:
 - 1. The neutral grounding resistor will consist of high-grade chromium stainless steel or nichrome elements and terminals of high corrosion resistance, double insulated, durable for long years of service, and having extremely high & stable electrical resistivity.
 - 2. Size resistor for continuous operation under voltage and current conditions identified on the project drawings.
 - 3. Edgewound type with welded connections between units.
 - 4. Edgewound helix strap wound around a refractory core reinforced by longitudinal steel supports.
 - 5. Each resistor element individually supported at each end by ceramic insulators in such a manner that one end of the helix bar support is freely attached to a roller which shall permit expansion f the supporting bar when subject to high temperatures.
 - 6. Resistor elements shall be electrically joined by stainless steel connectors welded to the stainless-steel terminals to provide a positive electrical path. From neutral connection point to ground connectors, all electrical circuitry shall be welded.
 - 7. Resistor shall have provisions for direct terminations of incoming neutral cable and grounding conductor in dedicated conduit stub ups through the concrete mounting pad and inside the safety frame enclosure.
 - 8. Furnish ground bus with mechanical lugs suitable for No. 2 AWG to 4/0 AWG bare copper wire.
 - 9. In addition to ground bus lugs, furnish mechanical ground lugs suitable for No. 2 AWG to 4/0 AWG bare copper wire diagonally opposite legs.
 - 10. If more than one resistor frame is required, series connections will be solid copper bus on grid style resistors, teflon wire on wirewound style resistors.
 - 11. The resistor frame(s) will be mounted on standoff insulators with a rating equal to or greater than the line-to-neutral voltage.
 - 12. The resistor will be time rated for 10 second 76 deg C (168 deg F) rise extended time 61 deg C (142 deg F) rise continuous 38.5 deg C (101 deg F).
 - 13. Suitable for operation without derating at the site conditions.
 - 14. High Voltage Units (Above 600 Volts Line-to-Line)
 - a. Assemblies will utilize an open frame free-standing enclosure housing both the control section and the high voltage compartment with step-down transformer. Furnish enclosure with legs to elevate enclosure minimum six inches (6") above top of concrete pad.
 - b. Painted galvanneal steel, ANSI-61 gray.
 - 15. Furnished with removable lifting angles and/or plates for crane hooks or slings for ease of transport and installation, and/or removable base channels for positioning with rollers.
 - 16. Sufficient space for mounting current transformers and other specified control equipment and accessories.
 - 17. Enclosure sides will be removable to allow for access during construction and maintenance.

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- 18. CONTROLS
 - a. All control circuitry will operate on 120 Volts AC.

- b. All control wiring will be 14 AWG minimum, rated at 600 Volts AC. Wiring must be sufficiently supported within the enclosure.
- c. The high resistance neutral grounding equipment will contain the following equipment on an operator's panel on the front of the unit as standard:
 - 1) Line Disconnect Switch
 - 2) Test Push-button
 - 3) A digital display unit containing the following functions:
 - a) Fault Reset Push-button
 - b) Green Light to Indicate "Normal" Operating Status
 - c) Flashing red Light to Indicate "Fault" Status
 - d) Red Light to Indicate "Harmonic" Status
 - e) Fault reset push-button
 - f) Alarm silence push-button
 - g) Pulse on/off push-button
 - h) Amber light to indicate "pulse" status
 - i) Indication of Under-Voltage condition
 - j) Indication of Under-Current condition
 - k) Ethernet IP port for Communications. Provide protocol convertor as required.
 - 1) Software to Configure and Monitor system remotely
 - m) Software to Data Log / Trend abnormal conditions
 - n) Single setpoint Meter Relay
- d. Other standard equipment is as follows:
 - 1) Alarm Relaying for Local and Remote Annunciation
 - 2) Pulsing Contactor and Timer
 - 3) Grounding Transformer(s) High Voltage Units Only
 - 4) Copper Grounding Buss Free Standing Units Only
- e. The relay to monitor fundamental voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.
- f. The relay to monitor harmonic voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.
- g. The optional portable ground detector will be a "split core" type ammeter with a multiple range switch. The clamp must be capable of enveloping a minimum 6" diameter. A short circuiting switch should be provided, along with a carrying case. The handle must be insulated for use on 15,000 volt system.
- h. Product and Manufacturer: Provide one of the following:
 - 1) Post Glover
 - 2) General Electric Industrial
 - 3) Hilkar Electric Inc.
 - 4) Milwaukee Resistor Corp.
 - 5) Avtron Loadbank Inc.
 - 6) Or engineer approved equal

2.3 SWITCHGEAR MANUFACTURERS

- A. Product and Manufacturer: Provide one of the following:
 - 1. Schneider Electric
 - 2. Siemens
 - 3. GE Power
 - 4. Or engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Install equipment on concrete pad as shown on the Drawings. Coordinate pad dimensions to fit equipment furnished.

3.2 FACTORY TESTS

A. The manufacturer shall perform standard factory tests on each circuit breaker. The factory tests shall be witnessed by the ENGINEER. Include the cost of the witness testing in the price. The cost shall include all transportation, lodging and meals.

3.3 FIELD INSPECTION AND TESTS

- A. Provide the services of an authorized service representative of the equipment manufacturer to make site visits to supervise the field testing to be performed by CONTRACTOR. The manufacturer's representative shall inform the OWNER if the equipment has been correctly installed and shall submit the factory and field test results to the OWNER and ENGINEER. The manufacturer's representative shall certify, in writing, that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. Perform the following minimum tests and checks before energizing equipment.
 - 1. Perform insulation resistance tests on each bus section, phase-to-phase and each phase-to-ground for a period of one minute at 2500 VDC. Minimum insulation resistance shall be 5000 megohms.
 - 2. After successful completion of insulation resistance test, perform an overpotential test on each bus section, each phase-to-ground for a period of one minute at manufacturer's recommended voltage.
 - 3. Inspect all mechanical and electrical interlocks for proper operation.
 - 4. Perform insulation resistance test on all control wiring at 1000 VDC after disconnecting devices. Minimum, measured insulation resistance shall be one megohm.
- C. The manufacturer shall submit the test results to the ENGINEER to confirm that the switchgear assembly design has been tested to substantiate conformance with the applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the switch or integrated switch and fuse, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the switchgear assembly shall be factory tested in accordance with ANSI Standard C37.20.3. and these Specifications.
- D. Perform any other tests recommended by the equipment manufacturer.

3.4 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 3 visits, minimum 8 hours on-site for each visit,

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to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be for training. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the 15 KV switchgear conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

3.5 FIELD ADJUSTMENTS

A. Relay settings on the microprocessor protective device shall be performed by CONTRACTOR in the field in accordance with the recommended settings designated in the coordination study.

++ END OF SECTION ++
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MEDIUM-VOLTAGE PAD-MOUNTED SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals, including concrete pad, as shown on the Drawings, specified and required to furnish and install free-standing medium-voltage pad-mounted switchgear complete and operational.
 - 2. The pad-mounted gear shall consist of a single self-supporting enclosure, containing source load break switches and feed vacuum fault interrupter switches with the necessary accessory components, all completely factory-assembled and operationally checked. The interrupter switches shall be enclosed within an inner grounded steel compartment for electrical isolation and for protection from contamination. Switch terminals shall be equipped with bushings rated 600 amperes continuous and bus terminals shall be equipped with bushing wells rated 200 amperes continuous to provide for elbow connection. Bushings and bushing wells shall be mounted on the walls of the inner compartment and shall extend into termination compartments. A termination compartment shall be provided for each three-phase switch and each three-phase set of bus terminals.
 - 3. Provide anchorage and support design, including seismic, for medium-voltage padmounted switchgear in accordance with General Electrical Provisions under Division 26.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.
 - 1. of ANSI C57.12.28, covering enclosure integrity for pad-mounted equipment.
 - 2. Article 710.21(e) in the National Electrical Code.
 - 3. All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch components.
 - 4. NFPA 70, National Electrical Code.
 - 5. UL, Underwriters Laboratories.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for equipment proposed for use. Submittals shall include the following:
 - a. Dimensional information.
 - b. Three-line diagrams.
 - c. Technical specifications.

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- d. Catalog cuts.
- e. Construction details of enclosure.
- B. Certification of Ratings: Submit for approval copies of certifications as follows:
 - 1. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type to be furnished under this Specification. Certified test abstracts establishing such ratings shall be furnished.
- C. Operation and Maintenance Manuals:
 - 1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.

PART 2 - PRODUCTS

2.1 RATINGS

A. The ratings for each integrated switch assembly shall be as shown on the drawings.

2.2 MATERIALS

- A. General:
 - 1. The manufacturer of the pad-mounted gear shall be completely and solely responsible for the performance of the basic switch components as well as the complete integrated assembly as rated.
 - 2. The manufacturer shall furnish, upon request, certification of ratings of the basic switch components and/or the integrated pad-mounted gear assembly consisting of the switch components in combination with the enclosure.
 - 3. Switches shall utilize less-flammable FR3 type insulating dielectric media.
- B. Insulators
 - 1. The interrupter-switch mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
 - a. Operating experience of at least 25 years under similar conditions.
 - b. Adequate leakage distance established by test per IEC Publication 507, "Artificial Pollution Test on High Voltage Insulators to be Used on AC Systems."
 - c. Adequate strength for short-circuit stress established by test.
 - d. Conformance with applicable ANSI standards.
 - e. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
- C. High-Voltage Bus
 - 1. Bus and interconnections shall consist of aluminum bar of 56% IACS conductivity.
 - 2. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted gear.

- 3. Bolted aluminum-to-aluminum connections shall be made with a suitable number of galvanized steel bolts, with two Belleville spring washers per bolt, one under the bolt head and one under the nut. Bolts shall be tightened to 50 foot-pounds torque.
- 4. Before installation of the bus, all electrical contact surfaces shall first be prepared by machine-abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
- 5. Tie bus, where furnished, shall consist of continuous, one-piece sections of aluminum bar with no intermediate splices. Flexible braid or cable shall not be used.
- D. Provisions for Grounding
 - 1. A ground-connection pad shall be provided in each termination compartment of the pad-mounted gear.
 - 2. The ground-connection pad shall be constructed of no less than 3/8-inch-thick steel. It shall be nickel plated and welded to the enclosure and shall have a short-circuit rating equal to that of the pad-mounted gear.
 - 3. Ground-connection pads shall be coated with a uniform coating of an oxide inhibitor and sealant prior to shipment.
 - 4. A copper rod, connected to the ground-connection pad, shall be provided in each termination compartment for switches and bus. The rod shall have a diameter no less than 3/8-in. and extend across the full width of the compartment to allow convenient grounding of cable concentric neutrals and accessories and shall have a short-circuit rating equal to that of the pad-mounted gear.
 - 5. Continuous copper ground bus shall be provided across the full width of each termination compartment for fuses. For each fuse mounting, there shall be a ground ring made of 3/8-inch diameter copper rod bolted to the ground bus and placed to allow convenient grounding of cable concentric neutrals and accessories. Ground rings and bus shall have a short-circuit rating equal to that of the pad-mounted gear
- E. Bushings and Bushing Wells
 - 1. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386.
 - 2. Bushings and bushing wells shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
 - a. Operating experience of at least 15 years under similar conditions.
 - b. Adequate leakage distance for in-air application established by test per IEC Publication 507, "Artificial Pollution Test on High Voltage Insulators to be Used on AC Systems."
 - c. Adequate strength for short-circuit stress established by test.
 - d. Conformance with applicable ANSI standards.
 - e. Homogeneity of the cycloaliphatic epoxy resin throughout each bushing or bushing well to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation.
 - 3. Bushings and bushing wells shall be mounted in such a way that the semiconductive coating is solidly grounded to the enclosure.
 - 4. Bushings rated 600 amperes continuous shall have a removable threaded stud so that the bushings are compatible with all 600 ampere elbow systems—those requiring a threaded stud as well as those that do not.
- F. Termination Compartments

- 1. Termination compartments for switches shall have bushings, and termination compartments for fuses shall have bushing wells to permit connection of elbows. The bushings and bushing wells shall be mounted on the interior walls at a minimum height of 33 inches above the enclosure base.
- 2. Termination compartments for bus shall have bushing wells to permit connection of elbows. The bushing wells shall be mounted on the interior walls at a minimum height of 25 inches above the enclosure base.
- 3. Termination compartments for bushings rated 600 amperes continuous shall be of an adequate depth to accommodate two 600 ampere elbows mounted piggyback, encapsulated surge arresters or grounding elbows mounted on 600 ampere elbows having 200 ampere interfaces, or other similar accessory combinations without the need for an enclosure extension.
- 4. Termination compartments for bushing wells rated 200 amperes continuous shall be of an adequate depth to accommodate 200 ampere elbows mounted on portable feed-thrus or standoff insulators, or other similar accessory combinations without the need for an enclosure extension.
- 5. Termination compartments shall be provided with one parking stand for each bushing or bushing well. The parking stand shall be located immediately adjacent to the associated bushing or bushing well and shall accommodate standard feedthroughs and standoff insulators, and other similar accessories.
- 6. Each termination compartment for a switch shall be equipped with a viewing window to allow visual inspection of interrupter switch blades to allow positive verification of switch position.
- 7. Each termination compartment for a set of fuses shall be equipped with a set of viewing windows to allow visual inspection of blown-fuse indicators.
- G. Enclosure
 - 1. The pad-mounted gear enclosure shall be of unitized monocoque (not structuralframe-and-bolted-sheet) construction to maximize strength, minimize weight, and inhibit corrosion.
 - 2. The basic material shall be 11-gauge hot-rolled, pickled and oiled steel sheet.
 - 3. All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. The gas-metal-arc welding process shall be employed to eliminate alkaline residues and to minimize distortion and spatter.
 - 4. To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
 - 5. The base shall consist of continuous 90 degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
 - 6. The door openings shall have 90 degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.
 - 7. Gasketing between the roof and the enclosure shall guard against entry of water and airborne contaminants and shall discourage tampering or insertion of foreign objects.
 - 8. An internal steel-enclosed compartment shall encase the interrupter switches and fuses for electrical isolation and protection from contamination. The compartment shall have a galvanized steel sheet floor to exclude foliage and animals. The floor shall have screened drain vents to allow drainage if the enclosure is flooded. The top of this compartment shall be gasketed to provide sealing with the enclosure roof.
 - 9. Insulating barriers of NEMA GPO3-grade fiberglass-reinforced polyester shall be provided for each interrupter switch where required to achieve BIL ratings. Additional insulating barriers of the same material shall isolate the tie bus (where furnished).
 - 10. Full-length steel barriers shall separate adjoining termination compartments.

- 11. Lifting tabs shall be removable. Sockets for the lifting-tab bolts shall be blind-tapped. A resilient material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be closed-cell to prevent moisture from being absorbed and held between the tabs and the enclosure in the event that lifting tabs are not removed.
- 12. The enclosure shall be provided with an instruction manual holder.
- 13. The following optional feature should be specified as required:
- 14. To guard against corrosion due to extremely harsh environmental conditions, the entire exterior of the enclosure shall be fabricated from 11-gauge Type 304 stainless steel.
- H. Interrupter Switches
 - 1. Interrupter switches shall be enclosed in an inner steel compartment and shall be provided with bushings rated 600 amperes continuous to permit connection of elbows external to the switch compartment.
 - 2. Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the pad-mounted gear. These ratings define the ability to close the interrupter switch three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.
 - 3. Interrupter switches shall be operated by means of an externally accessible 3/4 inch hex switch-operating hub. The switch-operating hub shall be located within a recessed stainless-steel pocket mounted on the side of the pad-mounted gear enclosure and shall accommodate a 3/4-inch deep-socket wrench or a 3/4-inch shallow-socket wrench with extension. The switch-operating-hub pocket shall include a padlockable stainless-steel access cover that shall incorporate a hood to protect the padlock shackle from tampering. Stops shall be provided on the switch-operating hub to prevent overtravel and thereby guard against damage to the interrupter switch quick-make quick-break mechanism. Labels to indicate switch position shall be provided in the switch-operating-hub pocket.
 - 4. Each interrupter switch shall be provided with a folding switch-operating handle. The switch-operating handle shall be secured to the inside of the switch-operating-hub pocket by a brass chain. The folded handle shall be stored behind the closed switch-operating-hub access cover.
 - 5. Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer. The quick-make quick-break mechanism shall be integrally mounted on the switch frame and shall swiftly and positively open and close the interrupter switch independent of the switch-operating-hub speed.
 - 6. Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.
 - 7. Interrupter switch contacts shall be backed up by stainless-steel springs to provide constant high contact pressure.
 - 8. Interrupter switches shall be provided with a single blade per phase for circuit closing, including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted. Interrupter switch blade

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supports shall be permanently molded in place in a unified insulated shaft constructed of the same cycloaliphatic epoxy resin as the insulators.

- 9. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place completely within the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a deionizing vent.
- 10. Optional features:
 - a. Key interlocks shall be provided to prevent paralleling the two source interrupter switches.
 - b. Key interlocks shall be provided to guard against opening the door(s) of fusetermination compartment(s) unless all switches are locked open.
 - c. Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each switch-termination compartment.
 - d. Interrupter switch bushings rated 600 amperes continuous shall be provided without studs.

2.3 LABELING

- A. Hazard-Alerting Signs
 - 1. All external doors shall be provided with "Warning—Keep Out—Hazardous Voltage Inside—Can Shock, Burn, or Cause Death" signs.
 - 2. The inside of each door shall be provided with a "Danger—Hazardous Voltage—Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.
 - 3. Termination compartments shall be provided with "Danger—Keep Away—Hazardous Voltage—Will Shock, Burn, or Cause Death" signs.
- B. Nameplates, Ratings Labels, and Connection Diagrams
 - 1. The outside of each door (or set of double doors) shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.
 - 2. The inside of each door (or set of double doors) shall be provided with a ratings label indicating the following:
 - a. Overall pad-mounted gear ratings: nominal voltage, kV; maximum voltage, kV; BIL voltage, kV; power frequency, Hz; short-circuit peak withstand current, amperes, peak; short-circuit one-second short-time withstand current, amperes, RMS, symmetrical; and short-circuit MVA, three-phase symmetrical, at rated nominal voltage.
 - b. Main bus ratings: continuous current, amperes; peak withstand current, amperes, peak; and one-second short-time withstand current, amperes, RMS symmetrical.
 - c. Switch ratings: continuous current, amperes; load splitting current, amperes; load dropping current, amperes; peak withstand current, amperes, peak; one-second short-time withstand current, amperes, RMS, symmetrical; and three-time duty-cycle fault-closing current, amperes, RMS symmetrical and amperes, peak.
 - d. Fuse type and ratings: maximum current, amperes and interrupting current, amperes, RMS, symmetrical.

3. A three-line connection diagram showing interrupter switches, fuses, and bus along with the manufacturer's model number shall be provided on the inside of each door (or set of double doors), and on the inside of each switch-operating-hub access cover.

2.4 ACCESSORIES

- 1. End fittings and fuse unit, holder and refill unit, or interrupting module and control module shall be furnished for each fuse mounting. In addition, one spare fuse unit, refill unit, or interrupting module shall be furnished.
- 2. A voltage tester with audio-visual signal capability shall be provided, along with batteries, shotgun clamp-stick adapter, and storage case.
- B. A shotgun clamp stick (8 feet, 5 1/2 inches) in length shall be provided complete with canvas storage bag.

2.5 MANUFACTURERS

- A. Product and Manufacturer: Provide one of the following:
 - 1. Maddox
 - 2. Cooper Electric
 - 3. General Electric Company
 - 4. Siemens
 - 5. Or engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Install equipment on concrete pad, as shown on the Drawings. Coordinate the pad dimensions to fit equipment furnished.

3.2 FIELD INSPECTION AND TESTS

- A. Provide the services of an authorized service representative of the equipment manufacturer to make site visits to supervise the field-testing to be performed by CONTRACTOR. The manufacturer's representative shall inform the OWNER if the equipment has been correctly installed and shall submit the factory and field test results to the OWNER. The manufacturer's representative shall certify, in writing, that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. Perform the following minimum tests and checks before energizing equipment:
 - 1. Perform insulation resistance tests on each bus section, phase-to-phase and each phase-to-ground for a period of one minute at 2500 VDC.
 - 2. After successful completion of insulation resistance test, perform an overpotential test on each bus section, each phase-to-ground for a period of one minute at manufacturer's recommended voltage.

- 3. Inspect all mechanical and electrical interlocks for proper operation.
- 4. Perform insulation resistance test on all control wiring at 1000 VDC after disconnecting devices.
- C. The manufacturer shall supply test results to confirm that the switchgear assembly design has been tested to substantiate conformance with the applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the switch or integrated switch and relay, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the switchgear assembly shall be factory tested in accordance with all applicable ANSI Standards and the Contract Documents.
- D. Perform any other tests recommended by the equipment manufacturer.

3.3 MANUFACTURER'S SERVICES

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the medium-voltage switches conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

++ END OF SECTION ++

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DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes all work related to surface water and groundwater control. All work in this Section shall be considered as Incidental Work to the completion of the Work in which it pertains.
- B. Furnish all labor, materials, equipment and incidentals required to remove, treat and dispose of all surface water and groundwater entering excavation areas.
- C. In the event that groundwater is encountered, excavation must stop in the affected area and the conditions and submittals of this Section must be met prior to resuming within the affected area.

1.2 DEFINITIONS

- A. Deep Excavation: Deep excavation shall be defined as any excavation extending below water surface elevation. Water surface elevation is located approximately six feet below ground surface.
- B. Groundwater Levels and Initial Groundwater Levels: Groundwater levels shall be defined as the levels of the groundwater in a specific area as measured at any time during construction by the Geotechnical Engineer through observations and records made within observation wells installed at the site. Initial groundwater levels shall be defined as the levels measured prior to the start of construction.

1.3 REFERENCES

- A. National Pollution Discharge Elimination System (NPDES) permit
- B. Utah Division of Water Quality (DWQ) regulations

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittal Procedures, showing details of dewatering system.
- B. Dewatering Plan:
 - 1. Thirty working days prior to commencing excavation or prior to the planned start of work affecting the flow in any major sewer or within plant site, the CONTRACTOR shall submit to the OWNER six copies of a detailed Dewatering Plan for approval. The CONTRACTOR shall also send a copy of the dewatering Plan to DWQ for approval. The CONTRACTOR shall provide evidence to the OWNER that the above agency has approved the dewatering plan.

- 2. Review and approval of the CONTRACTOR's dewatering plan by the OWNER and regulatory agencies shall not relieve the CONTRACTOR of the responsibility for the adequacy of the dewatering system to achieve the specified result.
- 3. The dewatering plan shall include:
 - a. Drawings of the proposed groundwater control system showing locations, dimensions and relationships of elements of each system and proposed discharge points locations.
 - b. Description of the proposed groundwater control system but not limited to, equipment, standby equipment, and power supply., means of measuring inflow to excavations, pollution control facilities, means of measuring discharge quantity.
 - c. Method of handling, treating, dewatering, and disposing of sanitary and ground water.
 - d. Design calculations demonstrating adequacy of proposed dewatering system and components.
 - e. Schedule of installation. The submittal shall delineate the sequence for dewatering with respect to completion of the final structure and limitations on the termination of dewatering.
 - f. Statement of the CONTRACTOR'S awareness and intent to comply with the OWNER's sewer discharge requirements.
 - g. Flow rates and storm drain discharge volumes.
 - h. Proposed points of discharge to the storm drain.
 - i. Details of the system operation plan and its portability.
 - j. Contingency plans for interruption or failure of the proposed groundwater control system.
 - k. Disposal plan for the settled waste, and floatable and oily wastes.
 - I. The storm drain discharge application/permit.
- 4. CONTRACTOR shall hire a Professional Civil Engineer, Registered Geologist or Registered Hydrogeologist in the State of Utah to prepare a dewatering plan.
- 5. If the dewatering system is modified during installation or operation, the CONTRACTOR shall revise or amend and resubmit the dewatering plan.

1.5 DESIGN REQUIREMENTS

- A. General:
 - 1. The CONTRACTOR is responsible for the proper design and implementation of methods for controlling surface water and groundwater. CONTRACTOR shall be responsible for the continuous control of groundwater at all times during the course of the construction, including Saturdays, Sundays, holidays, work stoppages, during periods of labor strikes, and during periods of work stoppages.
 - 2. Maintain all dewatering systems full time (24-hours/day) during the entire time the excavation is open. Do not shut down dewatering systems at night, on weekends or on holidays, or any other time the excavation is open.
 - 3. CONTRACTOR shall obtain a groundwater discharge permit from DWQ.
 - 4. The CONTRACTOR shall submit a dewatering control plan; provide monthly updates of dewatering activities and analytical results of the discharged water to ENGINEER and OWNER, in accordance with the requirements of the groundwater discharge permit.
 - 5. The CONTRACTOR shall be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering or surface water control operations.

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- 6. The CONTRACTOR shall provide 100 percent emergency power backup with automatic startup and switchover in the event of electric power failure.
- 7. Design review and field monitoring activities by the OWNER or by the ENGINEER shall not relieve the CONTRACTOR of his/her responsibilities for the work.
- 8. CONTRACTOR shall hire a Professional Civil Engineer, Registered Geologist or Registered Hydrogeologist in the State of Utah to design and direct the operation of dewatering system to:
 - a. Prevent loss of ground as water is removed.
 - b. Relieve artesian pressures and resultant uplift of excavation bottom.
 - c. Ensure dry conditions at the final lines and grades of the bottom of the excavation.
- B. Dewatering System:
 - 1. The CONTRACTOR shall use personnel experienced in furnishing, installing and monitoring dewatering systems to provide and maintain at all times during construction, ample means and adequate devices with which to promptly dewater and properly dispose of all water 3-feet below deepest excavation when required.
 - 2. The primary purpose of the groundwater control system is to preserve the natural undisturbed condition of the subgrade soils in the areas of the proposed excavations. Additional groundwater lowering may be necessary beyond the 3-ft requirement, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. The CONTRACTOR is responsible for lowering the groundwater as necessary to complete construction in accordance with the Contract Documents at no additional cost to the OWNER.
 - 3. Design deep wells, well points and sumps, and all other groundwater control system components to prevent loss of fines from surrounding soils. Sand filters shall be used with all dewatering installations unless screens are properly sized by the CONTRACTOR's design ENGINEER to prevent passage of fines from surrounding soils.
 - 4. The CONTRACTOR shall perform pre-conditions surveys of job site.
 - 5. The CONTRACTOR shall design, furnish, install, test, operate, meter the flow, using a flow meter capable to measure units in gpm, monitor and maintain the dewatering system including all discharge piping and connections at point of discharge. The CONTRACTOR shall be responsible to design a system that shall ensure that the excavation and removal of underground obstructions occurs in a dry environment. Hydrostatic pressures shall be properly relieved to prevent excessive seepage of water into the excavation, which may create instability to the sides and bottom of the excavation.
 - 6. Uptake lines to the settling tank(s) shall be screened and set in the excavation to minimize uptake of sediment and/or other contaminants. Outflow from the settling tank(s) shall be by gravity only, no pumping. The outflow capacity shall be sufficient to accommodate the rate of inflow while meeting applicable discharge standards. The CONTRACTOR shall provide a sufficient number of properly configured settling tanks to prevent any delay to his/her operation.
 - 7. The CONTRACTOR shall have sufficient redundancy in the treatment system and standby/backup units to safeguard against breakthrough of the primary units and to keep the excavation free of water in event of component failure. Standby pumping equipment shall be maintained on the job site.
 - 8. The CONTRACTOR shall furnish multiple systems to handle flows at each discharge location he/she proposes to discharge. The groundwater shall be discharged at locations approved by the OWNER.

- 9. Dewatering shall commence after dewatering plan has been reviewed and approved by the OWNER, when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise.
- 10. The CONTRACTOR shall include worksite traffic controls at the dewatering locations that enter into vehicular or pedestrian pathway.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping, pumping equipment and all other materials required to provide dewatering of excavations shall be suitable for the intended purpose. Standby pumping units shall be maintained at the site to be used in case of failure of the normal pumping units.
- B. A noise attenuation system is required for dewatering pumps producing noise louder than 65 dBA at 23 feet from pump.

PART 3 - EXECUTION

3.1 GENERAL

- A. Continuously control all water during the course of construction, including surface water and ground water, to prevent any damage to any excavation or to the construction activities occurring within those excavations.
- B. Maintain all dewatering systems full time (24-hours/day) during the entire time the excavation is open. Do not shut down dewatering systems at night, on weekends or on holidays, or any other time the excavation is open.
- C. Provide and maintain proper equipment and facilities to remove all water entering each excavation to be kept dry during subgrade and pipe bedding preparation and continually thereafter until the structure to be built, or the pipe to be installed therein is inspected by the OWNER and the ENGINEER and backfill operations have been completed.
- D. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, and combinations thereof.
- E. Where groundwater levels are above the proposed bottom of excavation level, a pumped dewatering system will be required for <u>pre-drainage</u> of the soils prior to excavation, and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged.
- F. Provide adequate alarm, monitoring and back-up systems for all dewatering systems to maintain control of all water during all times any excavation is open.
- G. All work included in this Section shall be done in a manner which will protect adjacent structures and utilities and shall not cause loss of ground or disturbance to the pipe bearing soils or to soils which support overlying or adjacent structures.

- H. Temporary dewatering and drainage systems shall be in place and operational prior to beginning excavation work.
- I. Install, monitor and report groundwater data from observation wells as necessary. Evaluate the collected data relative to groundwater control system performance and modify systems as necessary to dewater the site in accordance with the Contract Documents.
- J. Take all additional precautions to prevent uplift of any structure during construction. All such arrangements shall be subject to the approval of the ENGINEER.
- K. All damage resulting from failure to properly dewater excavations shall be repaired to the satisfaction of the ENGINEER at no additional cost to the OWNER.

3.2 SURFACE WATER CONTROL

- A. Provide and maintain adequate drainage and dewatering system to prevent surface water from entering excavations and to remove and dispose of all rainwater entering excavations, trenches, or other parts of the Work.
- B. Keep the different working areas on the site free of surface water at all times. Special care will be taken to eliminate depressions that could serve as mosquito pools.
- C. The diversion and removal of surface water will be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.

3.3 GROUND WATER CONTROL

- A. Provide, operate and maintain dewatering system to permit excavation and subsequent construction activities in a dry, safe environment.
- B. System shall be of sufficient size and capacity to maintain groundwater level a minimum of 3 feet below the lowest point of excavation.
- C. CONTRACTOR shall make an assessment of the potential for dewatering induced settlement of surrounding soils and structures. CONTRACTOR shall provide all necessary equipment and facilities, including re-injection wells, cutoff walls, infiltration trenches, etc, to prevent damage to adjacent structures.
- D. In no event shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of the pipe by promptly placing backfill.
- E. Excavation dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed condition of the subgrade soils at the proposed bottom of excavation.
- F. If the subgrade of the trench or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the ENGINEER and refill with structural fill or other material as approved by the ENGINEER at the CONTRACTOR's expense.

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G. It is expected that the initial dewatering plan may have to be modified to suit the variable soil/water conditions to be encountered during construction. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures or instability of the excavation.

3.4 OBSERVATION WELLS

- A. ENGINEER may require installation of observation well(s) to monitor groundwater levels beneath and around the excavated area until adjacent structures and pipelines are completed and backfilled.
- B. Locations and depths of observation wells are subject to approval by the OWNER and the ENGINEER.
- C. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the ENGINEER.
- D. The CONTRACTOR shall maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
- E. The groundwater level shall be kept at a minimum of 2-ft below the lowest trench level for a given excavation.

3.5 REMOVAL OF DEWATERING SYSTEM

A. At the completion of the excavation and backfilling work, and when approved by the ENGINEER, all pipe, pumps, generators, observation wells, other equipment and accessories used for the groundwater and surface water control systems shall be removed from the site. All materials and equipment shall become the property of the CONTRACTOR. All areas disturbed by the installation and removal of groundwater control systems and observation wells shall be restored to their original condition.

3.6 DISPOSAL OF WATER

- A. Disposal of discharge water shall conform to any and all applicable permit requirements as described in the Contract Specification Section 01 57 23, Temporary Storm Water Pollution Control.
- B. If CONTRACTOR chooses to dispose water into the OWNER's existing stormwater collection and drainage system, the following shall be met prior to disposal of water:
 - 1. CONTRACTOR shall obtain a stormwater discharge permit to discharge in the OWNER's stormwater collection and drainage system. CONTRACTOR shall obtain the necessary permit and notify the OWNER 15 days in advance prior to begin disposing groundwater or surface water to OWNER's stormwater collection and drainage system.
 - 2. Unless otherwise directed by the OWNER the CONTRACTOR shall discharge all dewatered groundwater to the drainage system through settling tank(s), with sediment traps and oil/water separators. The CONTRACTOR may select his/her own dewatering system. The CONTRACTOR shall furnish, install and operate sufficient

equipment to allow all dewatering flows to reside in the settling tanks for minimum of one hour. The system shall include all required pumps, hoses, fittings and accessories as necessary to contain and handle the dewatering flows.

- 3. It is CONTRACTOR's responsibility to provide all equipment or assistance to make the confined space safe for entry by the OWNER or his/her representative per the OSHA requirements.
- 4. The CONTRACTOR shall make allowances for seasonal and daily fluctuations in the storm water flow when dewatering or controlling ground water control within the project limits.
- 5. Should the existing groundwater be uncontaminated, and subsequently become contaminated due to the CONTRACTOR's operations, all costs related to satisfactory cleanup and disposal shall be the responsibility of the CONTRACTOR. Such costs shall include redesign, re-construction, pretreatment and, sewer service permit and usage fees costs necessary to satisfy the above requirements.

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