PROJECT MANUAL

STORM EYE INSTITUTE
CHILLER REPLACEMENT – PHASE II

Project Number: H51-9841-ML

FOR

MEDICAL UNIVERSITY OF SOUTH CAROLINA
Charleston, South Carolina

SEPTEMBER 21, 2018

BID DOCUMENTS

MECA Project Number 117189
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**PROJECT NUMBER:** H51-9841-ML

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INVITATION FOR DESIGN-BID-BUILD CONSTRUCTION SERVICES

AGENCY/OWNER: Medical University of South Carolina
PROJECT NAME: Storm Eye Institute Chiller Replacement - Phase II
PROJECT NUMBER: H51-9841-ML
PROJECT LOCATION: MUSC, Storm Eye Institute, Charleston SC
DESCRIPTION OF PROJECT/SERVICES: Remove existing 200 ton and 350 ton air cooled chillers (and associated piping) from Storm Eye Institute roof and install new 600 ton water cooled chiller and 600 ton cooling tower on roof of Children’s Hospital. Provide new chilled water and condenser water pumps. There will be a $45,000 allowance for controls.

BID/SUBMITTAL DUE DATE: 11/29/2018  CONSTRUCTION COST RANGE: $1,000,000 to $2,000,000

PROJECT DELIVERY METHOD: Design-Bid-Build

BID SECURITY IS REQUIRED IN AN AMOUNT NOT LESS THAN 5% OF THE BASE BID.
PERFORMANCE BOND REQUIRED? Yes ☒ No ☐  PAYMENT BOND REQUIRED? Yes ☒ No ☐

BIDDING DOCUMENTS/PLANS MAY BE OBTAINED FROM:
http://academicdepartments.musc.edu/vpf/eamdf/construction_project/index.html

PLAN DEPOSIT AMOUNT: $ n/a  IS DEPOSIT REFUNDABLE? Yes ☒ No ☐ N/A ☐

Bidders must obtain Bidding Documents/Plans from the above listed source(s) to be listed as an official plan holder. Bidders that rely on copies obtained from any other source do so at their own risk. All written communications with official plan holders & bidders will be via email or website posting.

All questions & correspondence concerning this Invitation shall be addressed to the A/E.
A/E CONTACT: Kevin L. Stanley
A/E ADDRESS: Street/PO Box: 2330 Main Street
City: Columbia  State: SC  ZIP: 29201-
EMAIL: kstanley@mecainc.com  TELEPHONE: 803-765-9421

AGENCY PROJECT COORDINATOR: Robert C. Branson
ADDRESS: Street/PO Box: 101 Doughty Street, Room 302
City: Charleston  State: SC  ZIP: 29425-
EMAIL: bransonr@musc.com  TELEPHONE: 843-792-7502

PRE-BID CONFERENCE: Yes ☒ No ☐  MANDATORY ATTENDANCE: Yes ☐ No ☒
PRE-BID DATE: 11/5/2018  TIME: 10:00AM  PLACE: 97 Jonathan Lucas St., Room 203A (Prior Room # was 209), Charleston, SC 29425

BID DUE DATE: _See Above_  TIME: 10:30AM  PLACE: 97 Jonathan Lucas St., Room 203A (Prior Room # was 209), Charleston, SC 29425

BID DELIVERY ADDRESSES:
HAND-DELIVERY: Attn: Robert C. Branson
97 Jonathan Lucas St., Room 203A (Prior Room # was 209)
Charleston, SC 29425

MAIL SERVICE: Attn: Robert C. Branson  c/o Kim Young
MUSC Engineering & Facilities, 28 Ehrhardt St., MSC109
Charleston, SC 29425

IS PROJECT WITHIN AGENCY CONSTRUCTION CERTIFICATION? (Agency MUST check one)  Yes ☐ No ☒

APPROVED BY: [Signature]  DATE: 10/24/2018

(Own Project Manager)
South Carolina Division of Procurement Services, Office of the State Engineer Version of AIA® Document A701™ – 1997

Instructions to Bidders

This version of AIA Document A701™–1997 is modified by the South Carolina Division of Procurement Services, Office of the State Engineer ("SCOSE"). Publication of this version of AIA Document A701–1997 does not imply the American Institute of Architects’ endorsement of any modification by SCOSE. A comparative version of AIA Document A701–1997 showing additions and deletions by SCOSE is available for review on the SCOSE Web site.

South Carolina Division of Procurement Services, Office of the State Engineer Version of AIA Document A701™ – 1997

Instructions to Bidders

for the following PROJECT:
(Name and location or address)
Storm Eye Institute Cailler Replacement - Phase II
Medical University of South Carolina, Charleston SC

THE OWNER:
(Name, legal status and address)
Medical University of South Carolina
28 Ehrhardt Street, MSC109
Charleston, South Carolina 29425

The Owner is a Governmental Body of the State of South Carolina as defined by Title 11, Chapter 35 of the South Carolina Code of Laws, as amended.

THE ARCHITECT:
(Name, legal status and address)
Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

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8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
ARTICLE 1  DEFINITIONS
§ 1.1 Bidding Documents, collectively referred to as the Invitation for Bids, include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement, Instructions to Bidders, Supplementary Instructions to Bidders, the Bid Form, the Notice of Intent to Award, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions). Drawings, Specifications and all Addenda issued prior to execution of the Contract, and other documents set forth in the Bidding Documents. Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101*, or some abbreviated reference thereof, shall mean AIA Document A101*-2007 Standard Form of Agreement Between Owner and Contractor, SCOSE edition. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean AIA Document A201*-2007 General Conditions of the Contract for Construction, SCOSE edition.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2  BIDDER'S REPRESENTATIONS
§ 2.1 The Bidder by submitting a Bid represents that:
§ 2.1.1 The Bidder has read and understands the Bidding Documents and Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction. Bidders are expected to examine the Bidding Documents and Contract Documents thoroughly and should request an explanation of any ambiguities, discrepancies, errors, omissions, or conflicting statements. Failure to do so will be at the Bidder's risk. Bidder assumes responsibility for any patent ambiguity that Bidder does not bring to the Owner's attention prior to bid opening.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents and accepts full responsibility for any pre-bid existing conditions that would affect the Bid that could have been ascertained by a site visit. As provided in Regulation 19-445.2042(B), a bidder's failure to attend an advertised pre-bid conference will not excuse its responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the State.
§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

§ 2.1.5 CERTIFICATION OF INDEPENDENT PRICE DETERMINATION
GIVING FALSE, MISLEADING, OR INCOMPLETE INFORMATION ON THIS CERTIFICATION MAY RENDER YOU SUBJECT TO PROSECUTION UNDER SECTION 16-9-10 OF THE SOUTH CAROLINA CODE OF LAWS AND OTHER APPLICABLE LAWS.

§ 2.1.5.1 By submitting a bid, the bidder certifies that:
  .1 The prices in this bid have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other bidder or competitor relating to:
    .1 those prices;
    .2 the intention to submit a bid; or
    .3 the methods or factors used to calculate the prices offered.
  .2 The prices in this bid have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other bidder or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and
  .3 No attempt has been made or will be made by the bidder to induce any other concern to submit or not to submit a bid for the purpose of restricting competition.

§ 2.1.5.2 Each signature on the bid is considered to be a certification by the signatory that the signatory:
  .1 Is the person in the bidder's organization responsible for determining the prices being offered in this bid, and that the signatory has not participated and will not participate in any action contrary to Section 2.1.5.1 of this certification; or
  .2 Has been authorized, in writing, to act as agent for the bidder's principals in certifying that those principals have not participated, and will not participate in any action contrary to Section 2.1.5.1 of this certification [As used in this subdivision, the term "principals" means the person(s) in the bidder's organization responsible for determining the prices offered in this bid];
  .3 As an authorized agent, does certify that the principals referenced in Section 2.1.5.2.2 of this certification have not participated, and will not participate, in any action contrary to Section 2.1.5.1 of this certification; and
  .4 As an agent, has not personally participated, and will not participate, in any action contrary to Section 2.1.5.1 of this certification.

§ 2.1.5.3 If the bidder deletes or modifies Section 2.1.5.1.2 of this certification, the bidder must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

§ 2.1.6 DRUG FREE WORKPLACE
By submitting a bid, the Bidder certifies that Bidder will maintain a drug free workplace in accordance with the requirements of Title 44, Chapter 107 of South Carolina Code of Laws, as amended.

§ 2.1.7 CERTIFICATION REGARDING DEBARMENT AND OTHER RESPONSIBILITY MATTERS
§ 2.1.7.1 By submitting a Bid, Bidder certifies, to the best of its knowledge and belief, that:
  .1 Bidder and/or any of its Principals-
    .1 Are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any state or federal agency;
    .2 Have not, within a three-year period preceding this bid, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of bids; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and
    .3 Are not presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in Section 2.1.7.1.1.2 of this provision.
  .2 Bidder has not, within a three-year period preceding this bid, had one or more contracts terminated for default by any public (Federal, state, or local) entity.
§ 2.1.7.2 Bidder shall provide immediate written notice to the Procurement Officer if, at any time prior to contract award, Bidder learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

§ 2.1.7.3 If Bidder is unable to certify the representations stated in Section 2.1.7.1, Bidder must submit a written explanation regarding its inability to make the certification. The certification will be considered in connection with a review of the Bidder's responsibility. Failure of the Bidder to furnish additional information as requested by the Procurement Officer may render the Bidder nonresponsible.

§ 2.1.7.4 Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by Section 2.1.7.1 of this provision. The knowledge and information of a Bidder is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

§ 2.1.7.5 The certification in Section 2.1.7.1 of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Bidder knowingly or in bad faith rendered an erroneous certification, in addition to other remedies available to the State, the Procurement Officer may terminate the contract resulting from this solicitation for default.

§ 2.1.8 ETHICS CERTIFICATE
By submitting a bid, the bidder certifies that the bidder has and will comply with, and has not, and will not, induce a person to violate Title 8, Chapter 13 of the South Carolina Code of Laws, as amended (Ethics Act). The following statutes require special attention: Section 8-13-700, regarding use of official position for financial gain; Section 8-13-705, regarding gifts to influence action of public official; Section 8-13-720, regarding offering money for advice or assistance of public official; Sections 8-13-755 and 8-13-760, regarding restrictions on employment by former public official; Section 8-13-775, prohibiting public official with economic interests from acting on contracts; Section 8-13-790, regarding recovery of kickbacks; Section 8-13-1150, regarding statements to be filed by consultants; and Section 8-13-1342, regarding restrictions on contributions by contractor to candidate who participated in awarding of contract. The state may rescind any contract and recover all amounts expended as a result of any action taken in violation of this provision. If the contractor participates, directly or indirectly, in the evaluation or award of public contracts, including without limitation, change orders or task orders regarding a public contract, the contractor shall, if required by law to file such a statement, provide the statement required by Section 8-13-1150 to the procurement officer at the same time the law requires the statement to be filed.

§ 2.1.9 RESTRICTIONS APPLICABLE TO BIDDERS & GIFTS
Violation of these restrictions may result in disqualification of your bid, suspension or debarment, and may constitute a violation of the state Ethics Act.

§ 2.1.9.1 After issuance of the solicitation, bidder agrees not to discuss this procurement activity in any way with the Owner or its employees, agents or officials. All communications must be solely with the Procurement Officer. This restriction may be lifted by express written permission from the Procurement Officer. This restriction expires once a contract has been formed.

§ 2.1.9.2 Unless otherwise approved in writing by the Procurement Officer, bidder agrees not to give anything to the Owner, any affiliated organizations, or the employees, agents or officials of either, prior to award.

§ 2.1.9.3 Bidder acknowledges that the policy of the State is that a governmental body should not accept or solicit a gift, directly or indirectly, from a donor if the governmental body has reason to believe the donor has or is seeking to obtain contractual or other business or financial relationships with the governmental body. Regulation 19-445.2165(C) broadly defines the term donor.
ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 COPIES

§ 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement in the number and for the deposit sum, if any, stated therein. If so provided in the Advertisement, the deposit will be refunded to all plan holders who return the Bidding Documents in good condition within ten (10) days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

§ 3.1.2 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

§ 3.1.3 The Owner has made copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

§ 3.1.4 All persons obtaining Bidding Documents from the issuing office designated in the Advertisement shall provide the office with Bidder's contact information to include the Bidder's name, telephone number, mailing address, and email address.

§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least ten (10) days prior to the date for receipt of Bids.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by written Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them. As provided in Regulation 19-445.2042(B), nothing stated at the pre-bid conference shall change the Bidding Documents unless a change is made by written Addendum.

§ 3.3 SUBSTITUTIONS

§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. Reference in the Bidding Documents to a designated material, product, thing, or service by specific brand or trade name followed by the words “or equal” and “or approved equal” shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition.

§ 3.3.2 No request to substitute materials, products, or equipment for materials, products, or equipment described in the Bidding Documents and no request for addition of a manufacturer or supplier to a list of approved manufacturers or suppliers in the Bidding Documents will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten (10) days prior to the date for receipt of Bids established in the Invitation for
§ 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 4 ADDENDA
§ 4.1.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 4.3.2 Addenda will be issued no later than 120 hours prior to the time for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

§ 4.5 When the date for receipt of Bids is to be postponed and there is insufficient time to issue a written Addendum prior to the original Bid Date, the Owner will notify prospective Bidders by telephone or other appropriate means with immediate follow up with a written Addendum. This Addendum will verify the postponement of the original Bid Date and establish a new Bid Date. The new Bid Date will be no earlier than the fifth (5th) calendar day after the date of issuance of the Addendum postponing the original Bid Date.

§ 4.6 If an emergency or unanticipated event interrupts normal government processes so that bids cannot be received at the government office designated for receipt of bids by the exact time specified in the solicitation, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal government processes resume. In lieu of an automatic extension, an Addendum may be issued to reschedule bid opening. If state offices are closed at the time a pre-bid or pre-proposal conference is scheduled, an Addendum will be issued to reschedule the conference.

ARTICLE 4 BIDDING PROCEDURES
§ 4.1 PREPARATION OF BIDS
§ 4.1.1 Bids shall be submitted on the SE-330 Bid Form included with the Bidding Documents.

§ 4.1.2 Any blanks on the bid form to be filled in by the Bidder shall be legibly executed in a non-erasable medium. Bids shall be signed in ink or other indelible media.

§ 4.1.3 Sums shall be expressed in figures.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid. Bidder shall not make stipulations or qualify his bid in any manner not permitted on the bid form. An incomplete Bid or information not requested that is written on or attached to the Bid Form that could be considered a qualification of the Bid, may be cause for rejection of the Bid.

§ 4.1.5 All requested Alternates shall be bid. The failure of the bidder to indicate a price for an Alternate shall render the Bid non-responsive. Indicate the change to the Base Bid by entering the dollar amount and marking, as appropriate, the box for “ADD TO” or “DEDUCT FROM”. If no change in the Base Bid is required, enter “ZERO” or “No Change.”
For add alternates to the base bid. Subcontractor(s) listed on page BF-2 of the Bid Form to perform Alternate Work shall be used for both Alternates and Base Bid Work if Alternates are accepted.

§ 4.1.6 Pursuant to Title 11, Chapter 35, Section 3020(b)(i) of the South Carolina Code of Laws, as amended, Section 7 of the Bid Form sets forth a list of subcontractor specialties for which Bidder is required to identify only those subcontractors Bidder will use to perform the work of each listed specialty. Bidder must follow the Instructions in the Bid Form for filling out this section of the Bid Form. Failure to properly fill out Section 7 may result in rejection of Bidder’s bid as non-responsive.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent’s authority to bind the Bidder.

§ 4.2 BID SECURITY

§ 4.2.1 If required by the Invitation for Bids, each Bid shall be accompanied by a bid security in an amount of not less than five percent of the Base Bid. The bid security shall be a bid bond or a certified cashier’s check. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.

§ 4.2.2 If a surety bond is required, it shall be written on AIA Document A310, Bid Bond. and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney. The bond shall:

.1 be issued by a surety company licensed to do business in South Carolina;
.2 be issued by a surety company having, at a minimum, a “Best Rating” of “A” as stated in the most current publication of “Best’s Key Rating Guide, Property-Casualty”, which company shows a financial strength rating of at least five (5) times the contract price.
.3 be enclosed in the bid envelope at the time of Bid Opening, either in paper copy or as an electronic bid bond authorization number provided on the Bid Form and issued by a firm or organization authorized by the surety to receive, authenticate and issue binding electronic bid bonds on behalf the surety.

§ 4.2.3 By submitting a bid bond via an electronic bid bond authorization number on the Bid Form and signing the Bid Form, the Bidder certifies that an electronic bid bond has been executed by a Surety meeting the standards required by the Bidding Documents and the Bidder and Surety are firmly bound unto the State of South Carolina under the conditions provided in this Section 4.2.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and performance and payment bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

§ 4.3 SUBMISSION OF BIDS

§ 4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall, unless hand delivered by the Bidder, be addressed to the Owner’s designated purchasing office as shown in the Invitation for Bids. The envelope shall be identified with the Project name, the Bidder’s name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail or special delivery service (UPS, Federal Express, etc.), the envelope should be labeled “BID ENCLOSED” on the face thereof. Bidders hand delivering their Bids shall deliver Bids to the place of the Bid Opening as shown in the Invitation for Bids. Whether or not Bidders attend the Bid Opening, they shall give their Bids to the Owner’s procurement officer or his/her designee as shown in the Invitation for Bids prior to the time of the Bid Opening.

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.
§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

§ 4.3.5 The official time for receipt of Bids will be determined by reference to the clock designated by the Owner’s procurement officer or his/her designee. The procurement officer conducting the Bid Opening will determine and announce that the deadline has arrived and no further Bids or bid modifications will be accepted. All Bids and bid modifications in the possession of the procurement officer at the time the announcement is completed will be timely, whether or not the bid envelope has been date/time stamped or otherwise marked by the procurement officer.

§ 4.4 MODIFICATION OR WITHDRAWAL OF BID
§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be withdrawn in person or by written notice to the party receiving Bids at the place designated for receipt of Bids. Withdrawal by written notice shall be in writing over the signature of the Bidder.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS
§ 5.1 OPENING OF BIDS
§ 5.1.1 Bids received on time will be publicly opened and will be read aloud. The Owner will not read aloud Bids that the Owner determines, at the time of opening, to be non-responsive.

§ 5.1.2 At bid opening, the Owner will announce the date and location of the posting of the Notice of Intended Award.

§ 5.1.3 The Owner will send a copy of the final Bid Tabulation to all Bidders within ten (10) working days of the Bid Opening.

§ 5.1.4 If the Owner determines to award the Project, the Owner will, after posting a Notice of Intended Award, send a copy of the Notice to all Bidders.

§ 5.1.5 If only one Bid is received, the Owner will open and consider the Bid.

§ 5.2 REJECTION OF BIDS
§ 5.2.1 The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

§ 5.2.2 The reasons for which the Owner will reject Bids include, but are not limited to:
   .1 Failure by a Bidder to be represented at a Mandatory Pre-Bid Conference or site visit;
   .2 Failure to deliver the Bid on time;
   .3 Failure to comply with Bid Security requirements, except as expressly allowed by law;
   .4 Listing an invalid electronic Bid Bond authorization number on the bid form;
   .5 Failure to Bid an Alternate, except as expressly allowed by law;
   .6 Failure to list qualified Subcontractors as required by law;
   .7 Showing any material modification(s) or exception(s) qualifying the Bid;
   .8 Faxing a Bid directly to the Owner or their representative; or
   .9 Failure to include a properly executed Power-of-Attorney with the bid bond.

§ 5.2.3 The Owner may reject a Bid as nonresponsive if the prices bid are materially unbalanced between line items or sub-line items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid
will result in the lowest overall cost to the Owner even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

§ 5.3 ACCEPTANCE OF BID (AWARD)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner’s judgment, is in the Owner’s own best interests.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 CONTRACTOR’S RESPONSIBILITY

Owner will make a determination of Bidder’s responsibility before awarding a contract. Bidder shall provide all information and documentation requested by the Owner to support the Owner’s evaluation of responsibility. Failure of Bidder to provide requested information is cause for the Owner, at its option, to determine the Bidder to be non-responsible.

§ 6.2 CLARIFICATION

Pursuant to Section 11-35-1520(8), the procurement officer may elect to communicate with a Bidder after opening for the purpose of clarifying either the Bid or the requirements of the Invitation for Bids. Such communications may be conducted only with Bidders who have submitted a Bid which obviously conforms in all material aspects to the Invitation for Bids and only in accordance with Appendix E (Paragraph A(6)) to the Manual for Planning and Execution of State Permanent Improvement, Part II. Clarification of a Bid must be documented in writing and included with the Bid. Clarifications may not be used to revise a Bid or the Invitation for Bids. [Section 11-35-1520(8); R.19-445.2080].

§ 6.3 SUBMITTALS

§ 6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:

1. a designation of the Work to be performed with the Bidder’s own forces;
2. names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and
3. names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 BOND REQUIREMENTS

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder’s usual sources.

§ 7.1.2 The performance and payment bonds shall conform to the requirements of Section 11.4 of the General Conditions of the Contract. If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid.

§ 7.2 TIME OF DELIVERY CONTRACT, CERTIFICATES OF INSURANCE AND FORM OF BONDS

§ 7.2.1 After expiration of the protest period, the Owner will tender a signed Contract for Construction to the Bidder and the Bidder shall return the fully executed Contract for Construction to the Owner within seven (7) days thereafter. The Bidder shall deliver the required bonds and certificate of insurance to the Owner not later than three (3) days following the date of execution of the Contract. Failure to deliver these documents as required shall entitle the Owner to consider the Bidder’s failure as a refusal to enter into a contract in accordance with the terms and conditions of the Bidder’s Bid and to make claim on the Bid Security for re-procurement cost.

§ 7.2.2 The bonds shall be dated on or after the date of the Contract.
§ 7.2.3 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101-2007, Standard Form of Agreement Between Owner and Contractor. SACE edition.

ARTICLE 9 MISCELLANEOUS
§ 9.1 NONRESIDENT TAXPAYER REGISTRATION AFFIDAVIT INCOME TAX WITHHOLDING IMPORTANT TAX NOTICE - NONRESIDENTS ONLY
§ 9.1.1 Withholding Requirements for Payments to Nonresidents: Section 12-8-550 of the South Carolina Code of Laws requires persons hiring or contracting with a nonresident conducting a business or performing personal services of a temporary nature within South Carolina to withhold 2% of each payment made to the nonresident. The withholding requirement does not apply to (1) payments on purchase orders for tangible personal property when the payments are not accompanied by services to be performed in South Carolina, (2) nonresidents who are not conducting business in South Carolina, (3) nonresidents for contracts that do not exceed $10,000 in a calendar year, or (4) payments to a nonresident who (a) registers with either the S.C. Department of Revenue or the S.C. Secretary of State and (b) submits a Nonresident Taxpayer Registration Affidavit - Income Tax Withholding, Form I-312 to the person letting the contract.

§ 9.1.2 For information about other withholding requirements (e.g., employee withholding), contact the Withholding Section at the South Carolina Department of Revenue at 803-898-5383 or visit the Department’s website at: www.sctax.org

§ 9.1.3 This notice is for informational purposes only. This Owner does not administer and has no authority over tax issues. All registration questions should be directed to the License and Registration Section at 803-898-5872 or to the South Carolina Department of Revenue, Registration Unit, Columbia, S.C. 29214-0140. All withholding questions should be directed to the Withholding Section at 803-898-5383.

PLEASE SEE THE "NONRESIDENT TAXPAYER REGISTRATION AFFIDAVIT INCOME TAX WITHHOLDING" FORM (Available through SC Department of Revenue).

§ 9.2 CONTRACTOR LICENSING
Contractors and Subcontractors listed in Section 7 of the Bid Form who are required by the South Carolina Code of Laws to be licensed, must be licensed at the time of bidding.

§ 9.3 SUBMITTING CONFIDENTIAL INFORMATION
§ 9.3.1 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the word "CONFIDENTIAL" every page, or portion thereof, that the Bidder contends contains information that is exempt from public disclosure because it is either (a) a trade secret as defined in Section 30-4-40(a)(1), or (b) privileged & confidential, as that phrase is used in Section 11-35-410.

§ 9.3.2 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the words "TRADE SECRET" every page, or portion thereof, that the Bidder contends contains a trade secret as that term is defined by Section 39-8-20 of the Trade Secrets Act.

§ 9.3.3 For every document the Bidder submits in response to or with regard to this solicitation or request, the Bidder must separately mark with the word "PROTECTED" every page, or portion thereof, that the Bidder contends is protected by Section 11-35-1810.

§ 9.3.4 All markings must be conspicuous: use color, bold, underlining, or some other method in order to conspicuously distinguish the mark from the other text. Do not mark your entire bid as confidential, trade secret, or protected! If your bid, or any part thereof, is improperly marked as confidential or trade secret or protected, the State may, in its sole discretion, determine it nonresponsive. If only portions of a page are subject to some protection, do not mark the entire page.

§ 9.3.5 By submitting a response to this solicitation, Bidder (1) agrees to the public disclosure of every page of every document regarding this solicitation or request that was submitted at any time prior to entering into a contract.
§ 9.3.6 In determining whether to release documents, the State will detrimentally rely on the Bidders’ marking of documents, as required by these bidding instructions, as being either "Confidential" or "Trade Secret" or "PROTECTED".

§ 9.3.7 By submitting a response, the Bidder agrees to defend, indemnify & hold harmless the State of South Carolina, its officers & employees, from every claim, demand, loss, expense, cost, damage or injury, including attorney’s fees, arising out of or resulting from the State withholding information that Bidder marked as "confidential" or "trade secret" or "PROTECTED".

§ 9.4 POSTING OF INTENT TO AWARD
The SE-370. Notice of Intent to Award, will be posted at the following location:
Room or Area of Posting: Lobby
Building Where Posted: 28 Ehrhardt Street, Charleston SC
Address of Building: 28 Ehrhardt Street, Charleston SC
WEB site address (if applicable): http://academicdepartments.musc.edu/vpf/eenb/construction_project/index.html
Posting date will be announced at bid opening. In addition to posting the notice, the Owner will promptly send all responsive bidders a copy of the notice of intent to award and the final bid tabulation.

§ 9.5 PROTEST OF SOLICITATION OR AWARD
§ 9.5.1 Any prospective bidder, offeror, contractor, or subcontractor who is aggrieved in connection with the solicitation of a contract shall protest within fifteen (15) days of the date of issuance of the applicable solicitation document at issue. Any actual bidder, offeror, contractor, or subcontractor who is aggrieved in connection with the intended award or award of a contract shall protest within ten (10) days of the date notification of intent to award is posted in accordance with Title 11, Chapter 35, Section 4210 of the South Carolina Code of Laws, as amended. A protest shall be in writing, shall set forth the grounds of the protest and the relief requested with enough particularity to give notice of the issues to be decided, and must be received by the State Engineer within the time provided.

§ 9.5.2 Any protest must be addressed to the CPO, Office of State Engineer, and submitted in writing:
.1 by email to protest-ose@musc.sc.gov,
.2 by facsimile at 803-737-0639, or
.3 by post or delivery to 1201 Main Street, Suite 600, Columbia, SC 29201.
By submitting a protest to the foregoing email address, you (and any person acting on your behalf) consent to receive communications regarding your protest (and any related protests) at the e-mail address from which you sent your protest.

§ 9.6 SOLICITATION INFORMATION FROM SOURCES OTHER THAN OFFICIAL SOURCE
South Carolina Business Opportunities (SCBO) is the official state government publication for State of South Carolina solicitations. Any information on State agency solicitations obtained from any other source is unofficial and any reliance placed on such information is at the bidder’s sole risk and is without recourse under the South Carolina Consolidated Procurement Code.

§ 9.7 BUILDER’S RISK INSURANCE
Bidders are directed to Article 11.3 of the South Carolina Modified AIA Document A201, 2007 Edition, which, unless provided otherwise in the bid documents, requires the contractor to provide builder’s risk insurance on the project.

§ 9.8 TAX CREDIT FOR SUBCONTRACTING WITH MINORITY FIRMS
§ 9.8.1 Pursuant to Section 12-6-3350, taxpayers, who utilize certified minority subcontractors, may take a tax credit equal to 4% of the payments they make to said subcontractors. The payments claimed must be based on work performed directly for a South Carolina state contract. The credit is limited to a maximum of fifty thousand dollars annually. The
taxpayer is eligible to claim the credit for 10 consecutive taxable years beginning with the taxable year in which the first payment is made to the subcontractor that qualifies for the credit. After the above ten consecutive taxable years, the taxpayer is no longer eligible for the credit. The credit may be claimed on Form TC-2, "Minority Business Credit." A copy of the subcontractor's certificate from the Governor's Office of Small and Minority Business (OSMBA) is to be attached to the contractor's income tax return.

§ 9.8.2 Taxpayers must maintain evidence of work performed for a State contract by the minority subcontractor. Questions regarding the tax credit and how to file are to be referred to: SC Department of Revenue, Research and Review, Phone: (803) 898-5786, Fax: (803) 898-5888.

§ 9.8.3 The subcontractor must be certified as to the criteria of a "Minority Firm" by the Governor's Office of Small and Minority Business Assistance (OSMBA). Certificates are issued to subcontractors upon successful completion of the certification process. Questions regarding subcontractor certification are to be referred to: Governor's Office of Small and Minority Business Assistance, Phone: (803) 734-0657, Fax: (803) 734-2498. Reference: SC §11-35-5010 — Definition for Minority Subcontractor & SC §11-35-5230 (B) — Regulations for Negotiating with State Minority Firms.

§ 9.9 OTHER SPECIAL CONDITIONS OF THE WORK

Use of crane lifts only on weekends.
AIA Document A310 - 2010, “Bid Bond”

is hereby made part of these documents.

An Original is on file in the Engineer’s Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201
BID SUBMITTED BY: ____________________________  
(Bidder’s Name)

BID SUBMITTED TO: Medical University of South Carolina  
(Owner’s Name)

FOR: PROJECT NAME: Storm Eye Institute Chiller Replacement – Phase II

PROJECT NUMBER: H51-9841-ML

OFFER

§ 1. In response to the Invitation for Construction Services and in compliance with the Instructions to Bidders for the above-named Project, the undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the Owner on the terms included in the Bidding Documents, and to perform all Work as specified or indicated in the Bidding Documents, for the prices and within the time frames indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

§ 2. Pursuant to SC Code § 11-35-3030(1), Bidder has submitted Bid Security as follows in the amount and form required by the Bidding Documents:

- \[\square\] Bid Bond with Power of Attorney
- \[\square\] Electronic Bid Bond
- \[\square\] Cashier’s Check  
(Bidder check one)

§ 3. Bidder acknowledges the receipt of the following Addenda to the Bidding Documents and has incorporated the effects of said Addenda into this Bid:

(Bidder, check all that apply. Note, there may be more boxes than actual addenda. Do not check boxes that do not apply)

ADDENDA: \[\square\] #1 \[\square\] #2 \[\square\] #3 \[\square\] #4 \[\square\] #5

§ 4. Bidder accepts all terms and conditions of the Invitation for Bids, including, without limitation, those dealing with the disposition of Bid Security. Bidder agrees that this Bid, including all Bid Alternates, if any, may not be revoked or withdrawn after the opening of bids, and shall remain open for acceptance for a period of 60 Days following the Bid Date, or for such longer period of time that Bidder may agree to in writing upon request of the Owner.

§ 5. Bidder herewith offers to provide all labor, materials, equipment, tools of trades and labor, accessories, appliances, warranties and guarantees, and to pay all royalties, fees, permits, licenses and applicable taxes necessary to complete the following items of construction work:

§ 6.1 BASE BID WORK (as indicated in the Bidding Documents and generally described as follows): Remove existing 200 ton and 350 ton air cooled chillers (and associated piping) from Storm Eye Institute roof and install new 600 ton water cooled chiller and 600 ton cooling tower on roof of Children’s Hospital. Provide new chilled water and condenser water pumps. There will be a $45,000 allowance for controls.

$ _________________________, which sum is hereafter called the Base Bid.  
(Bidder to insert Base Bid Amount on line above)
Bidder shall use the below-listed Subcontractors in the performance of the Subcontractor Specialty Classification work listed:

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<tr>
<th>(A) SUBCONTRACTOR SPECIALTY (Completed by Owner)</th>
<th>(B) CLASSIFICATION or SUBCLASSIFICATION ABBREVIATION (Completed by Owner)</th>
<th>(C) SUBCONTRACTOR'S or PRIME CONTRACTOR'S NAME (Required - must be completed by Bidder)</th>
<th>(D) SUBCONTRACTOR'S or PRIME CONTRACTOR'S SC LICENSE NUMBER (Requested, but not Required)</th>
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**BASE BID**

**ALTERNATE #1**

**ALTERNATE #2**

**ALTERNATE #3**

If a Bid Alternate is accepted, Subcontractors listed for the Bid Alternate shall be used for the work of both the Alternate and the Base Bid work.
1. Section 7 of the Bid Form sets forth an Owner-developed list of contractor/subcontractor specialties by contractor license classification or subclassification for which Bidder is required to identify the entity (subcontractor(s) and/or himself) Bidder will use to perform the work of each listed specialty.
   a. Columns A & B: The Owner fills out these columns to identify the contractor/subcontractor specialty and related license abbreviation for which the Bidder must list either a subcontractor or himself as the entity that will perform this work. In Column A, the subcontractor specialty is identified by name and in Column B, the related contractor license abbreviation (per Title 40 of the SC Code of Laws) is listed. Abbreviations of licenses can be found at: [http://www.llr.state.sc.us/POL/Contractors/PDFFiles/CLBClassificationAbbreviations.pdf](http://www.llr.state.sc.us/POL/Contractors/PDFFiles/CLBClassificationAbbreviations.pdf). If the owner has not identified a specialty, the Bidder does not list a subcontractor.
   b. Columns C and D: In these columns, the Bidder identifies the subcontractors it will use for the work of each specialty and license listed by the Owner in columns A & B. Bidder must identify only the subcontractor(s) who will perform the work and no others. Bidders should make sure that their identification of each subcontractor is clear and unambiguous. A listing that could be any number of different entities may be cause for rejection of the bid as non-responsive. For example, a listing of M&M without additional information may be problematic if there are multiple different licensed contractors in South Carolina whose names start with M&M.
2. Subcontractor Defined: For purposes of subcontractor listing, a subcontractor is an entity who will perform work or render service to the prime contractor to or about the construction site pursuant to a contract with the prime contractor. Bidder should not identify sub-subcontractors in the spaces provided on the bid form but only those entities with which Bidder will contract directly. Likewise, do not identify material suppliers, manufacturers, and fabricators that will not perform physical work at the site of the project but will only supply materials or equipment to the Bidder or proposed subcontractor(s).
3. Subcontractor Qualifications: Bidder must only list subcontractors who possess a South Carolina contractor’s license that includes the license classification and/or subclassification identified by the Owner in columns A & B. The subcontractor license must also be within the appropriate license group for the work of the specialty. If Bidder lists a subcontractor who is not qualified to perform the work, the Bidder will be rejected as non-responsive.
4. Use of Own forces: If, under the terms of the Bidding Documents and SC Contractor Licensing laws, Bidder is qualified to perform the work of a listed specialty and Bidder does not intend to subcontract such work but to use Bidder’s own employees to perform such work, the Bidder must insert its own name in the space provided for that specialty.
5. Use of Multiple Subcontractors:
   a. If Bidder intends to use multiple subcontractors to perform the work of a single specialty listing, Bidder must insert the name of each subcontractor Bidder will use, preferably separating the name of each by the word “and”. If Bidder intends to use both his own employees to perform a part of the work of a single specialty listing and to use one or more subcontractors to perform the remaining work for that specialty listing, Bidder must insert his own name and the name of each subcontractor, preferably separating the name of each with the word “and”. Bidder must use each entity listed for the work of a single specialty listing in the performance of that work.
   b. Optional Listing Prohibited: Bidder may not list multiple subcontractors for a specialty listing, in a form that provides the Bidder the option, after bid opening or award, to choose one or more but not all the listed subcontractors to perform the work for which they are listed. A listing, which on its face requires subsequent explanation to determine whether it is an optional listing, is non-responsive. If Bidder intends to use multiple entities to perform the work for a single specialty listing, Bidder must clearly set forth on the bid form such intent. Bidder may accomplish this by simply inserting the word “and” between the names of each entity listed for that specialty. Agency will reject as non-responsive a listing that contains the names of multiple subcontractors separated by a blank space, the word “or”, a virgule (that is a /), or any separator that the Agency may reasonably interpret as an optional listing.
6. If Bidder is awarded the contract, Bidder must, except with the approval of the Agency for good cause shown, use the listed entities to perform the work for which they are listed.
7. If Bidder is awarded the contract, Bidder will not be allowed to substitute another entity as subcontractor in place of a subcontractor listed in Section 7 of the Bid except for one or more of the reasons allowed by the SC Code of Laws.
8. Bidder’s failure to identify an entity (subcontractor or himself) to perform the work of a subcontractor specialty listed in columns A & B will render the Bid non-responsive.
§ 8. LIST OF MANUFACTURERS, MATERIAL SUPPLIERS, AND SUBCONTRACTORS OTHER THAN SUBCONTRACTORS LISTED IN SECTION 7 ABOVE (FOR INFORMATION ONLY):

Pursuant to instructions in the Invitation for Construction Services, if any, Bidder will provide to Owner upon the Owner’s request and within 24 hours of such request, a listing of manufacturers, material suppliers, and subcontractors, other than those listed in Section 7 above, that Bidder intends to use on the project. Bidder acknowledges and agrees that this list is provided for purposes of determining responsibility and not pursuant to the subcontractor listing requirements of SC Code § 11-35-3020(b)(i).

§ 9. TIME OF CONTRACT PERFORMANCE AND LIQUIDATED DAMAGES

a) CONTRACT TIME

Bidder agrees that the Date of Commencement of the Work shall be established in a Notice to Proceed to be issued by the Owner. Bidder agrees to substantially complete the Work within 270 Calendar Days from the Date of Commencement, subject to adjustments as provided in the Contract Documents.

b) LIQUIDATED DAMAGES

Bidder further agrees that from the compensation to be paid, the Owner shall retain as Liquidated Damages the amount of $500.00 for each Calendar Day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. This amount is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty for nonperformance.

§ 10. AGREEMENTS

a) Bidder agrees that this bid is subject to the requirements of the laws of the State of South Carolina.

b) Bidder agrees that at any time prior to the issuance of the Notice to Proceed for this Project, this Project may be canceled for the convenience of, and without cost to, the State.

c) Bidder agrees that neither the State of South Carolina nor any of its agencies, employees or agents shall be responsible for any bid preparation costs, or any costs or charges of any type, should all bids be rejected or the Project canceled for any reason prior to the issuance of the Notice to Proceed.

§ 11. ELECTRONIC BID BOND

By signing below, the Principal is affirming that the identified electronic bid bond has been executed and that the Principal and Surety are firmly bound unto the State of South Carolina under the terms and conditions of the AIA Document A310, Bid Bond, included in the Bidding Documents.

ELECTRONIC BID BOND NUMBER: ________________________________

SIGNATURE AND TITLE: ________________________________
SE-330
LUMP SUM BID FORM

CONTRACTOR'S CLASSIFICATIONS AND SUBCLASSIFICATIONS WITH LIMITATION

SC Contractor's License Number(s):__________________________________________________
Classification(s) & Limits:__________________________________________________________
Subclassification(s) & Limits:_______________________________________________________

By signing this Bid, the person signing reaffirms all representation and certification made by both
the person signing and the Bidder, including without limitation, those appearing in Article 2 of the
SCOSE Version of the AIA A701, Instructions to Bidders, is expressly incorporated by reference.

BIDDER'S LEGAL NAME:____________________________________________________________
ADDRESS:_______________________________________________________________________
______________________________________________________________________________
TELEPHONE:_______________________________________________________________________
EMAIL:_________________________________________________________________________

SIGNATURE:__________________________________ DATE:____________________
PRINT NAME:__________________________________________
TITLE:_________________________________________________
AIA Document A101- 2007,
“Standard Form of Agreement Between Owner and Contractor”

The Form of the Contract shall be the SCOSE Version of the AIA Document A101-2007, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, which is incorporated herein by reference. Sample of this document may be viewed in Appendix J.2 of the 2018 Edition of the OSE Manual, at https://procurement.sc.gov.
AIA Document A201- 2017,
“General Conditions of the Contract for Construction”
Articles 1 through 16, Pages 1 through 49,
is hereby made part of these documents.

An Original is on file in the Engineer’s Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201
I. PURPOSE

MUSC is committed to promoting a healthy, tobacco-free environment for its employees, faculty, students, visitors and patients. The purpose of this policy is to provide a healthy environment, minimize the negative effects of passive smoke and tobacco use, maximize fire safety and promote wellness and good health habits within all MUSC facilities, including MUSC affiliates, and the surrounding campus.

II. POLICY

A. Covered Individuals

The provisions of this policy shall apply to all employees (including faculty and staff), patients, visitors, students, volunteers, contractors and vendors unless otherwise noted.

B. Use of Tobacco Products

1. The use of any tobacco product is prohibited in all buildings, grounds and spaces either leased or owned by the Medical University. The Human Resources Management Policy No. 49, Tobacco-Free Campus, includes, but is not limited to, offices, classrooms, laboratories, elevators, stairwells,
restrooms, shuttle buses, shuttle bus stops, sidewalks, parking areas, meeting rooms, hallways, lobbies, and other common areas.

2. The use of tobacco products in University owned, operated or leased vehicles is prohibited.

3. Use of tobacco products is also prohibited in personal vehicles parked on MUSC property.

4. The use of tobacco products is prohibited on all streets and sidewalks within the Medical District as defined by the City of Charleston ordinance (see Medical District map).

5. MUSC also prohibits the use of tobacco products by staff on private properties adjacent to the Medical District without explicit approval from the property owner. Individuals should refrain from smoking in areas where smoke is likely to enter private property through entrances, windows, ventilation systems or other means and are expected to respect requests to refrain from smoking in particular areas if asked to do so by agents or employees of the University. Tobacco use on public property neighboring MUSC is highly discouraged.

6. Use of tobacco products while representing MUSC, wearing MUSC scrubs or uniforms, wearing an MUSC badge, or on paid break is prohibited.

C. List of Tobacco Products

Tobacco products include, but are not limited to, cigarettes, cigars, pipes, chewing tobacco, e-cigarettes and other smokeless tobacco products.

III. INFORMATION AND PROCEDURE

A. Faculty/Staff/Volunteers

1. Faculty, staff and volunteers are expected to comply with the Tobacco-Free Campus Policy and assist with sharing information about the policy.

2. New employees and volunteers will be informed of the Tobacco-Free Campus Policy during orientation.

3. Enforcement of the policy rests with the appropriate supervisory staff, deans, department heads and administrative officials.

4. When employees or volunteers observe violations of the policy, they should politely remind the offender of the policy and request that they dispose of tobacco materials.

5. If the employee or volunteer continues to violate the policy, the location and time of the violation should be reported to the appropriate supervisory staff, dean, department head or administrative official. Human Resources Employee Relations may also be contacted to report violations.
6. Violation patterns will be assessed and appropriate action initiated. Employees who are found to be in violation will be disciplined in accordance with the Human Resources Policy No. 45, Disciplinary Action. Action may range from written reprimand to termination. Refer to specific guidelines as outlined by MUSC, MUHA and UMA.

B. **Patients**

1. Faculty, staff and clinical staff with patient care responsibilities are responsible for communicating and ensuring compliance with the Tobacco-Free Campus Policy.

2. Upon admission/check-in, patients will be verbally informed of the policy and a copy will be provided upon request.

3. Patients violating MUSC's policy will be asked to dispose of tobacco materials.

4. Tobacco replacement therapies, i.e. nicotine patch, nicotine gum, etc., may be prescribed by the patient's physician.

C. **Visitors**

1. Visitors will be informed of the policy and asked to comply while they are on campus.

2. Signage will be posted throughout MUSC's buildings and grounds; stating this facility is a tobacco-free campus.

3. All employees and volunteers are encouraged to assist with the education of visitors regarding the policy, using policy information cards, which will be made available.

4. Employees are expected to help enforce the policy with visitors by requesting that they dispose of tobacco materials and respect MUSC's healthcare mission and tobacco-free campus.

5. If a visitor is observed repeatedly violating the policy after being advised of the policy, staff should note the location and time of the violation and contact their respective manager, Department of Public Safety or Medical Center Safety and Security, or Human Resources.

D. **Students**

1. New students will be informed of the Tobacco-Free Campus Policy during orientation.

2. Enforcement of the policy rests with the respective Dean's office.
3. When students observe violations of the policy, they should remind their fellow students of the policy and ask them to dispose of the tobacco materials.

4. If the student continues to violate the policy, the location and time of the violation should be reported to the appropriate Dean's office.

5. Violation patterns will be assessed and appropriate action initiated.

6. Affiliation agreements will include the Tobacco-Free Campus Policy so that students from other schools will be advised of the policy.

E. Contractors/Vendors

1. A provision will be inserted in all contracts, e.g. construction and/or maintenance, to prohibit the employees of contractors/vendors from using tobacco materials on property owned or leased by MUSC. Contractors and vendors are expected to ensure full compliance at all times with this policy by any employees and/or subcontractors providing services on MUSC property.

2. Failure by the contractor/vendor or their employees to comply with the provisions of this policy could result in contractors/vendors (or their employee(s) violating this policy) being asked to leave campus and/or the termination of the service contract with the contractor or vendor.

IV. ENFORCEMENT

A. The monitoring and enforcement of this policy is the responsibility of ALL MUSC/MUHA/UMA employees, students and volunteers. Each individual should consistently and politely bring any infraction of this policy to the attention of the person or persons observed violating the policy.

B. The MUSC Department of Public Safety and Medical Center Safety and Security will assist in the enforcement of this policy by reporting violations to the appropriate manager or supervisor. Employees are also expected to assume leadership roles by adhering to the policy provisions and by reminding others who aren't in compliance of the policy provisions.

C. MUSC will provide Tobacco-Free Campus Policy information cards to facilitate the education and enforcement of the policy.

V. RESOURCES

MUSC will offer resources and support to tobacco users in abstaining from tobacco use on campus and in supporting users who desire to quit using tobacco. Smoking cessation
classes and other tobacco education related resources or programs will be offered periodically for MUSC employees. Many of these programs are offered at little to no cost. Additional resources are outlined on the Tobacco-Free Campus website.

VI. EXCEPTIONS

Individuals enrolled in smoking research and/or treatment programs are permitted to smoke in designated smoking areas that are physically separated from care, treatment and service areas upon approval. If the Medical Center decides that patients may smoke in specific circumstances, it will designate smoking areas that are physically separated from care, treatment and service areas.

<table>
<thead>
<tr>
<th>Approved by:</th>
<th>Information Contact</th>
<th>Approved</th>
</tr>
</thead>
</table>
| Lisa P. Montgomery  
Vice President for  
Finance & Administration | Director of  
Human Resources  
Management | Effective  
March 1, 2012  
Revised  
June 2013 |
KEY:

- **MUSC Tobacco-Free Campus**
- **MUSC Tobacco-Free streets and sidewalks**
- **City of Charleston Smoke-Free Medical District streets and sidewalks**
- **Roper Hospital Tobacco-Free Campus**
SE-355
PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name: ____________________________________________
Address: _________________________________________

hereinafter referred to as “Contractor”, and (Insert full name and address of principal place of business of Surety)

Name: ____________________________________________
Address: _________________________________________

hereinafter called the “surety”, are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name: ____________________________________________
Address: _________________________________________

hereinafter referred to as “Agency”, or its successors or assigns, the sum of ______________________ ($ ____), being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated __________ entered into a contract with Agency to construct

State Project Name: Storm Eye Institute Chiller Replacement - Phase II
State Project Number: H51-9841-ML
Brief Description of Awarded Work: Remove existing 200 ton and 350 ton air cooled chillers (and associated piping) from Storm Eye Institute roof and install new 600 ton water cooled chiller and 600 ton cooling tower on roof of Children’s Hospital. Provide new chilled water and condenser water pumps.

in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)

Name: Mechanical Engineering Consulting Associates, Inc.
Address: 2330 Main Street
       Columbia, SC 29201

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED this ______ day of __________, 2 ______

BOND NUMBER ____________________________

(CONTRACTOR)

By: ________________________________ (Seal)
Print Name: ________________
Print Title: ________________________
Witness: _________________________

(SURETY)

By: ________________________________ (Seal)
Print Name: ________________
Print Title: ________________________
Witness: _________________________

(Additional Signatures, if any, appear on attached page)
NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency for the full and faithful performance of the contract, which is incorporated herein by reference.

2. If the Contractor performs the contract, the Surety and the Contractor have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. The Surety's obligation under this Bond shall arise after:
   3.1 The Agency has notified the Contractor and the Surety at the address described in paragraph 10 below, that the Agency is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If the Agency, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the Agency's right, if any, subsequently to declare a Contractor Default; or
   3.2 The Agency has declared a Contractor Default and formally terminated the Contractor's right to complete the Contract.

4. The Surety shall, within 15 days after receipt of notice of the Agency's declaration of a Contractor Default, and at the Surety's sole expense, take one of the following actions:
   4.1 Arrange for the Contractor, with consent of the Agency, to perform and complete the Contract; or
   4.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
   4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Agency for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the Agency and the contractor selected with the Agency's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the Agency the amount of damages as described in paragraph 7 in excess of the Balance of the Contract Sum incurred by the Agency resulting from the failure to act of the Surety under paragraph 4; or
   4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and:
      4.4.1 After investigation, determine the amount for which it may be liable to the Agency and, within 60 days of waiving its rights under this paragraph, tender payment thereof to the Agency; or
      4.4.2 Deny liability in whole or in part and notify the Agency, citing the reasons therefore.

5. Provided Surety has proceeded under paragraphs 4.1, 4.2, or 4.3, the Agency shall pay the Balance of the Contract Sum to:
   5.1 Surety in accordance with the terms of the Contract; or
   5.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

6. The balance of the Contract Sum due either the Surety or another contractor shall be reduced by the amount of damages as described in paragraph 7.

6.1 If the Surety proceeds as provided in paragraph 4.4 and the Agency refuses the payment tendered or the Surety has denied liability, in whole or in part, then without further notice the Agency shall be entitled to enforce any remedy available to the Agency.

6.2 Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the Dispute Resolution process defined in the Contract Documents and the laws of the State of South Carolina.

7. After the Agency has terminated the Contractor's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Agency shall be those of the Contractor under the Contract, and the responsibilities of the Agency to the Surety shall those of the Agency under the Contract. To a limit of the amount of this Bond, but subject to commitment by the Agency of the Balance of the Contract Sum to mitigation of costs and damages on the Contract, the Surety is obligated to the Agency without duplication for:
   7.1 The responsibilities of the Contractor for correction of defective Work and completion of the Contract; and
   7.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under paragraph 4; and
   7.3 Damages awarded pursuant to the Dispute Resolution Provisions of the Contract. Surety may join in any Dispute Resolution proceeding brought under the Contract and shall be bound by the results thereof; and
   7.4 Liquidated Damages, or if no Liquidated Damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. The Surety shall not be liable to the Agency or others for obligations of the Contractor that are unrelated to the Contract, and the Balance of the Contract Sum shall not be reduced or set-off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Agency or its heirs, executors, administrators, or successors.

9. The Surety hereby waives notice of any change, including changes of time, to the contract or to related subcontracts, purchase orders and other obligations.

10. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. Definitions
   11.1 Balance of the Contract Sum: The total amount payable by the Agency to the Contractor under the Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts to be received by the Agency in settlement of insurance or other Claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Contract.
   11.2 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform the Contract or otherwise to comply with the terms of the Contract.
KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name:  
Address:  

hereinafter referred to as “Contractor”, and (Insert full name and address of principal place of business of Surety)

Name:  
Address:  

hereinafter called the “surety”, are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name:  
Address:  

hereinafter referred to as “Agency”, or its successors or assigns, the sum of $ ( ), being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ________ entered into a contract with Agency to construct

State Project Name: Storm Eye Institute Chiller Replacement - Phase II  
State Project Number: H51-9841-ML  
Brief Description of Awarded Work: Remove existing 200 ton and 350 ton air cooled chillers (and associated piping) from Storm Eye Institute roof and install new 600 ton water cooled chiller and 600 ton cooling tower on roof of Children’s Hospital. Provide new chilled water and condenser water pumps.

in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)

Name: Mechanical Engineering Consulting Associates, Inc.  
Address: 2330 Main Street  
Columbia, SC 29201

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Labor & Material Payment Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED this ________ day of ________, 20____ BOND NUMBER __________________________

(shall be no earlier than Date of Contract)

CONTRACTOR  

By: __________________________  
(Seal)  

Print Name: __________________________  
Print Title: __________________________  
Witness: __________________________

SURETY  

By: __________________________  
(Seal)  

Print Name: __________________________  
Print Title: __________________________  
Witness: __________________________

(Attach Power of Attorney)

(Additional Signatures, if any, appear on attached page)
NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency to pay for all labor, materials and equipment required for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to the Agency, this obligation shall be null and void if the Contractor:
   2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and
   2.2 Defends, indemnifies and holds harmless the Agency 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 Contract.
3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.
4. With respect to Claimants, and subject to the provisions of Title 29, Chapter 5 and the provisions of §11-35-3030(2)(c) of the SC Code of Laws, as amended, the Surety’s obligation under this Bond shall arise as follows:
   4.1 Every person who has furnished labor, material or rental equipment to the Contractor or its subcontractors for the work specified in the Contract, and who has not been paid in full therefore before the expiration of a period of ninety (90) days after the date on which the last of the labor was done or performed by him or material or rental equipment was furnished or supplied by him for which such claim is made, shall have the right to sue on the payment bond for the amount, or the balance thereof, unpaid at the time of institution of such suit and to prosecute such action for the sum or sums justly due him.
   4.2 A remote claimant shall have a right of action on the payment bond upon giving written notice by certified or registered mail to the Contractor within ninety (90) days from the date on which such person did or performed the last of the labor or furnished or supplied the last of the material or rental equipment upon which such claim is made.
   4.3 Every suit instituted upon a payment bond shall be brought in a court of competent jurisdiction for the county or circuit in which the construction contract was to be performed, but no such suit shall be commenced after the expiration of one year after the day on which the last of the labor was performed or material or rental equipment was supplied by the person bringing suit.
5. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety’s expense take the following actions:
   5.1 Send an answer to the Claimant, with a copy to the Agency, within sixty (60) days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
   5.2 Pay or arrange for payment of any undisputed amounts.
   5.3 The Surety’s failure to discharge its obligations under this paragraph 5 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a claim. However, if the Surety fails to discharge its obligations under this paragraph 5, the Surety shall indemnify the Claimant for the reasonable attorney’s fees the Claimant incurs to recover any sums found to be due and owing to the Claimant.
6. Amounts owed by the Agency to the Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By the Contractor furnishing and the Agency accepting this Bond, they agree that all funds earned by the contractor in the performance of the Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Agency’s prior right to use the funds for the completion of the Work.
7. The Surety shall not be liable to the Agency, Claimants or others for obligations of the Contractor that are unrelated to the Contract. The Agency shall not be liable for payment of any 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.
8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.
9. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the Agency or the contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
10. By the Contractor furnishing and the Agency accepting this Bond, they agree that this Bond has been furnished to comply with the statutory requirements of the South Carolina Code of Laws, as amended, and further, that any provision in this Bond conflicting with said statutory requirements shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.
11. Upon request of any person or entity appearing to be a potential beneficiary of this bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.
12. Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the laws of the State of South Carolina.
13. DEFINITIONS
   13.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the Contractor and the Contractor’s Subcontractors, and all other items for which a mechanic’s lien might otherwise be asserted.
   13.2 Remote Claimant: A person having a direct contractual relationship with a subcontractor of the Contractor or subcontractor, but no contractual relationship expressed or implied with the Contractor.
   13.3 Contract: The agreement between the Agency and the Contractor identified on the signature page, including all Contract Documents and changes thereto.
CHANGE ORDER TO DESIGN-BID-BUILD CONSTRUCTION CONTRACT

AGENCY: Medical University of South Carolina
PROJECT NAME: Storm Eye Institute Chiller Replacement - Phase II
PROJECT NUMBER: H51-9841-ML

CONTRACTOR: ____________________________  CONTRACT DATE: ____________

This Contract is changed as follows: (Insert description of change in space provided below)

ADJUSTMENTS IN THE CONTRACT SUM:
1. Original Contract Sum: $__________
2. Change in Contract Sum by previously approved Change Orders: $__________
3. Contract Sum prior to this Change Order: $0.00
4. Amount of this Change Order: $__________
5. New Contract Sum, including this Change Order: $__________

ADJUSTMENTS IN THE CONTRACT TIME:
1. Original Substantial Completion Date: ____________
2. Sum of previously approved increases and decreases in Days: ____________ Days
3. Change in Days for this Change Order: ____________ Days
4. New Substantial Completion Date: ____________

CONTRACTOR ACCEPTANCE:
BY: ____________________________  Date: ____________
(Signature of Representative)
Print Name of Representative: ____________________________

A/E RECOMMENDATION FOR ACCEPTANCE:
BY: ____________________________  Date: ____________
(Signature of Representative)
Print Name or Representative: ____________________________

AGENCY ACCEPTANCE AND CERTIFICATION:
BY: ____________________________  Date: ____________
(Signature of Representative)
Print Name of Representative: ____________________________

Change is within Agency Construction Contract Change Order Certification of: $__________  Yes ☐  No ☐

AUTHORIZED BY: ____________________________  DATE: ____________
(OSE Project Manager)

SUBMIT THE FOLLOWING TO OSE:
1. SE-380, fully completed and signed by the Contractor, A/E and Agency;
2. Detailed back-up information, with OH&P shown, from the Contractor/Subcontractor(s) that justifies the costs and schedule changes shown.
3. If any item exceeds Agency certification, OSE will authorize the SE-380 and return to Agency.
SECTION 011000 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE

A. The overall scope of this project is to remove existing 200 ton and 350 ton air cooled chillers (and associated piping) from Storm Eye Institute roof and install new 600 ton water cooled chiller and 600 ton cooling tower on roof of Children’s Hospital at the MUSC. Provide new chilled water and condenser water pumps. Water cooled chiller and condenser water pumps, to be installed in weatherproof enclosure on new structural steel framing. Chilled water supply and return to be piped to existing chilled water roof penetrations. Modifications to the existing equipment include relocation and/or re-routing of a portion of the chilled water lines. A more detailed, but not exhaustive, list of scope requirements are shown below. The contractor should review drawings and specifications carefully to determine the complete scope of the project.

B. Removal, demolition, and replacement of exterior walls, louvers, roofs, ceilings, floors, structural steel, slabs, etc. required for the replacement of mechanical and electrical equipment, pumps, piping, control panels, valves, actuators, electrical equipment, conduits, etc.

C. Removal of two of the existing Storm Eye Institute chillers, including refrigerant reclamation.

D. Installation of a new variable volume, high efficiency centrifugal chiller, chilled water pumps and tower water pumps with inertia bases, chilled water and tower water piping systems, valves and water specialties to complete the installation of the new chiller at the Storm Eye Institute Building.

E. Electrical power and controls power for the new mechanical systems.

F. New variable speed drives to control the new variable volume chilled water pumps.

G. Removal, demolition, replacement, and new electrical equipment, components, conduits, devices, starters, disconnects, and systems to serve all of the new mechanical equipment, systems and controls.

H. Modifications and alterations to the building structural steel systems to accommodate new equipment installations.

I. Water protection for all electrical equipment during construction.

J. Modifications to the existing chilled water piping systems.

K. Insulation, painting and labeling of all new piping systems and valves in the facility included in this contract.

L. Vibration and seismic restraints for all new equipment, devices, piping installed under this contract.
M. Provide appropriate personnel, equipment, chemicals, and procedures to flush and treat the water system to remove debris and substances that could impair the performance of the heat transfer surfaces. Water samples shall be taken and analyzed by a chemical treatment company approved by the Engineer and witnessed by a representative from the Engineer’s office. The system shall be certified as ready for use prior to any equipment being placed into service.

N. Start, test, adjust, balance and place into operation all systems. The building water distribution systems as indicated on the plans and the refrigerant exhaust fan system are to be balanced to provide the quantity of air and water as shown on drawings.

O. Control system for the new chiller shall be compatible with the existing chiller control system in the facility. Chiller plant controls and integration to Johnson Controls system and campus EMS system is included in this contract. Installation of new isolation valves to allow continued chiller plant operation during construction of this project.

P. Project will have to be completed to ensure that existing Storm Eye Institute plant stays operational at all times.

Q. The scope includes all associated mechanical, electrical, structural, and control work.

R. Install refrigerant monitoring system.

1.2 TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. Time of completion: Unless an extension of time is granted, all work under this contract shall be substantially complete within 270 consecutive days from “Notice to Proceed”.

B. Liquidated Damages: Should the Contractor fail to substantially complete the work under this contract within the stipulated days plus any additional days that may result from extensions of time granted by the Owner, he agrees that the Owner may retain the sum of $500.00 per each calendar day, the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion. This amount is agreed upon as a reasonable and proper measure of Liquidated Damages, which the Owner sustains per day by failure of the Contractor to complete the work within the time stipulated. This sum is not to be construed in any sense as a penalty.

1.3 MANNER OF CONDUCT OF THE WORK

A. The existing building will be occupied during the “life of the contract”. The work shall be done and temporary facilities provided so that daily operations and essential services are not interrupted.

B. Noisy operations, such as drilling, hammering, etc. shall be restricted by the Owner to avoid disruption of daily activities. The Schedule of Operations shall be approved by the Owner.
C. No work shall be undertaken and no service shall be interrupted unless prior approval is received from the Owner at least ten (10) working days prior to the interruption. Every request from the Contractor to begin work in a new area or on another floor level or to interrupt any service or function must be made to the Owner sufficiently far in advance to allow review (at least five working days), approval and concurrence by the Owner’s Administrative Staff. All notifications to Owner and Engineer shall be in writing.

D. No jack-hammering will be allowed unless written permission is received from the Owner.

E. All holes will be core drilled using a diamond core drill.

F. The Contractor has sole responsibility for enforcing coordination requirements to prevent interruptions and for adhering closely to the schedule.

1.4 SPECIAL SITE CONDITIONS

A. The work area is inside, on and beside the facility which is in daily use by the staff and faculty. Bidders are specifically advised that storage and work space will be restricted. Encroachment beyond these limits by the Contractor shall be rigorously avoided. Material must be kept in a neat and orderly manner and work area must be kept clean.

B. Trash and debris must be removed by Contractor daily. No food or drink will be allowed inside the existing Building or any renovated areas.

C. Construction Parking: Parking at the building site will be restricted to one (1) parking space. Contractor will be responsible for workers travel to and from the project site from a remote parking site. Deliveries of equipment and materials will be via the building loading dock where applicable and shall be limited to loading and unloading only. NO UNATTENDED VEHICLES WILL BE ALLOWED. DRIVERS MUST REMAIN WITH THE VEHICLES.

1.5 ACCESS TO THE BUILDING AND STORAGE

A. The contractor will be permitted to bring workmen, material, equipment, etc., into the building through an entrance approved by MUSC.

B. Materials shall arrive on the site only as they are needed and immediately delivered to the limited construction area. Coordinate the construction site space needs with the Owner. Very limited space will be available outside the construction area.

C. Supplies, equipment and materials to be delivered to the construction area in closed containers sized to be conveniently transported through existing corridors and door openings.

D. The Contractor shall remove all waste material via the same route.

E. Remove all waste material from Owner’s property and legally dispose of it.

F. Debris, trash and unused materials shall be removed from the construction area and roof daily in closed containers which are sized to be conveniently transported through existing corridors and door openings.
1.6 WORK SCHEDULE

A. Working hours for this project will be 8:00 a.m. to 5:00 p.m. on weekdays. Nothing in the above work schedule shall void the Contractor’s option to perform overtime work if so desired. Also, some phases of the work can only be performed during off-hours, on weekends or at night. However, **the Contractor shall receive no additional compensation for overtime work performed.**

1. Contractor shall advise Owner of his intended work schedule and obtain their approval.
2. Contractor shall not do any electrical or mechanical work at any time which would interfere with the Owner’s service or function without first advising Owner of the nature, proposed time, and duration of the interruption and obtaining approval for the work.

B. The contractor shall present all requests for approval to the Owner not less than five working days before proposed work is scheduled to be done.

C. Nothing in the above-mentioned work schedule shall void the Contractor’s option to perform overtime work if he so desires and is so approved by the Owner. The Contractor is responsible for including all necessary cost to meet the schedule in the bid documents in the base bid. If the contractor requires overtime to meet the schedule in the bid documents, then the cost incurred are to be included in the base bid.

1.7 SAFETY COMPLIANCE

A. In addition to any detailed requirements of this specification, the contractor shall meet the requirements of federal and state standards referenced in Applicable Publications, whichever is more restrictive. Contractor must submit matters of interpretation of these standards to the respective administrative agency for resolution before starting work.

1.8 SEQUENCING OF CONSTRUCTION

A. It is the intent of these specifications that the work shall commence within ten (10) working days of the date of commencement as set forth in the “Notice to Proceed” and that all work shall be completed within the number of days specified.

B. The Contractor shall schedule the work in such a manner that will allow the Owner to fully occupy all spaces at all times. Scheduling of the work will be conducted with the contractor, the engineer and MUSC prior to commencement of the work.

C. No time extension shall be granted for equipment delivery.

END OF SECTION 011000
SECTION 011400 - CONTRACTOR’S USE OF PREMISES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section applies to situations in which the Contractor or his representatives including, but not necessarily limited to, suppliers, subcontractors, employees, and field engineers, entering upon the Owner's property.

B. Related Work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 01 of these Specifications.

1.2 QUALITY ASSURANCE

A. Promptly upon the award of the Contract, notify all pertinent personnel regarding requirements of this Section.

B. Require that all personnel who will enter upon the Owner's property certify their awareness of and familiarity with the requirements of this section.

1.3 TRANSPORTATION FACILITIES

A. Truck and equipment access:

1. To avoid traffic conflict with vehicles of the Owner's employees and customers, and to avoid over-loading of streets and driveways elsewhere on the Owner's property, limit the access of trucks and equipment to the designated "Contractor's Entrance".

2. Provide adequate protection for curbs and sidewalks over which trucks and equipment pass to reach the job site.

B. Contractor's vehicles:

1. Require contractor's vehicles, vehicles belonging to employees of the contractor, and all other vehicles entering the Owner's property in performance of the work of the contract, to use only the designated access route.

2. Do not permit such vehicles to park on any street or other area of the Owner's property except in the area to be designated.

1.4 SECURITY

A. Restrict the access of all persons entering upon the Owner's property in connection with the work to the contractor's entrance and to the actual site of the work.
1.5 PROTECTION OF EXISTING PROPERTY

A. This project involves work in and on the building. The contractor will be responsible for protecting existing items from damage during construction. This effort will be coordinated during the preconstruction meetings.

B. After the completion of the construction, the condition of the area shall be restored to its original appearance at the contractor's expense.

1.6 MISCELLANEOUS

A. Confine operations at site to areas permitted by Owner and Contract Documents.

B. Do not unreasonably encumber site with materials or equipment.

C. Do not load structure with weight that will endanger structure.

D. Assume full responsibility for protection and safekeeping of products stored on premises.

E. Move any stored products which interfere with operations of Owner.

1.7 MANNER OF CONDUCTION OF WORK

A. The existing buildings will be occupied during the life of the contract. The work shall be done and such temporary facilities provided, so as not to interfere with the daily operation of the building or any essential service thereof.

B. Noisy operations, such as drilling, etc shall be restricted by the Owner to avoid disruption of daily activities. The schedule of operation shall be approved by the Owner. No work shall be undertaken and no service shall be interrupted, which does not have the prior approval of the Owner. Every request from the contractor to begin work in a new area to interrupt any service shall have approval and concurrence by the Owner’s Administrative Staff.

C. No jackhammering will be allowed unless written permission is received from the Owner. All holes will be core drilled using a diamond core drill.

D. Responsibility from enforcing coordination requirements and close adherence to time schedule rests solely with the general contractor.

1.8 SPECIAL SITE CONDITIONS

A. Trash and debris shall be removed by contractor daily. No food or drink will be allowed inside the existing buildings or any renovated areas.
Medical University of South Carolina  
Storm Eye Institute Chiller Replacement – Phase II  
Project Number: H51-9841-ML

B. On-site storage and parking will be allowed only in designated area and shall be totally maintained by the General Contractor. This area shall suffice for employee parking, construction trailers and general storage of materials. If additional space is required it shall be the responsibility of the General Contractor to locate and furnish at no additional cost to the Owner. The contractor shall fence and secure the storage area as he deems necessary to secure and protect the area.

END OF SECTION 011400
SECTION 012100 - CASH ALLOWANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To provide adequate budget and bonding to cover items pre-ordered by Owner prior to advertising for bids, allow within the proposed contract amount the sums described below.

B. Contractors are referred to the General Conditions, Article 3, Paragraph 3.8 for conditions governing the inclusion of allowances in the contract sum.

1.2 ESTABLISHED METHODS

A. When a cash allowance is set for certain items or materials, it is understood that any savings under such allowance shall accrue to the Owner and if the material purchased costs more than the Allowance, such additional cost shall be borne by the Owner.

1.3 ALLOWANCES

A. Allowance shall include purchase of the equipment described below, delivery cost to the job site, and sales tax; does not include profit to the general contractor.

B. After receipt of bids, the previously ordered equipment shall become part of the scope of work of the general contractor at no additional cost to the Owner, except for the stipulated cash allowance as adjusted.

C. This method is established to allow general contractor to control scheduling of subcontractor so as to meet established completion date.

1.4 UNDESCRIBED ALLOWANCES

A. Allowances and provisions not further described in these specifications will be specified and bid at a later date.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM ALLOWANCE

A. Allow the sum of $45,000.00 in the base bid for installation of the control system as outlined in section 230900 of these specifications. This allowance shall cover the cost of the entire control system for this project.
PART 3 - EXECUTION

3.1 PROCEDURE

A. After receipt of bids for the project and award of Notice to Proceed, the successful Contractor will place a purchase order with Johnson Controls Inc. for installation of the control system. The installation and warranty of the control system shall become part of the scope of work of the Contractor at no additional cost to the Owner.

END OF SECTION 01 21 00
PART 1 - GENERAL

1.1 WORK INCLUDED

A. To establish a mandatory method or system of submitting and approval or disapproval of various items, materials, equipment, products etc., in lieu of those specified or indicated.

B. Related Work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. The contract is based on the standards of quality established in the Contract Documents but specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition and the Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgement of the Architect/Engineer expressed in writing, is equal to that named.

B. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometime resolves itself to a matter of personal opinion and judgement and in these and all other cases involving the approval of materials, the opinion, judgement and decision of the Architect/Engineer and the Owner shall be final and bind all parties concerned.

C. The following products do not require further approval except for interface within the work:

1. Products specified by reference to standard specifications such as ASTM & similar standards.
2. Products specified by manufacturer's name and catalog model number.

1.3 REQUEST FOR APPROVAL

A. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified must have been submitted for approval ten (10) calendar days prior to bid opening date to the Architect/Engineer.

B. Format of Request:

1. Requests must be submitted to the Architect/Engineer in writing.
2. The written request must clearly identify the specification section (and paragraph if appropriate) along with any deviations from the specified product specification.
3. Identify compliance with pertinent standards of quality as listed under the “Quality Assurance” paragraph of part one of the specification section. Identify any deviations or alternate standards of quality.

4. Requests must be accompanied by samples, descriptive literature, and engineering information as necessary to fully identify and allow appraisal of the product.

C. Failure to comply with either the time frame for approval or format for the approval request (as identified in paragraphs A & B above) is in itself sufficient cause for rejection of the approval request.

1.4 APPROVED SUBSTITUTIONS

A. Approval of the Architect/Engineer to use materials and/or equipment, if granted, will have been in the form of a written addendum and will have been issued to all bidders of record. Approved substitutions may be used at Contractor's option.

B. Approval of an item submitted as a request for approval does not relieve that product from compliance with the specification section performance, quality, construction, material or warranty requirements.

C. No substitutions will be allowed, nor will an increase in Contract be allowed (for using materials specified) if substitutions have been requested later than ten (10) days prior to bid opening date.

END OF SECTION 012500
SECTION 012900 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work for each project, as specified herein and in other provisions of the contract documents.

1.2 RELATED WORK
A. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 01 of these specifications.
B. A “Schedule of Values” is required under the General Conditions. The minimum division of categories shall comply with requirements of this specification. The “Schedule of Values” is required to be compatible with the “Continuation Sheet” accompanying application for payment.

1.3 QUALITY ASSURANCE
A. Use required means to assure arithmetical accuracy of the sums described.
B. When so required by the Engineer, provide copies of the subcontracts or other data acceptable to the Engineer, substantiating the sums described.

1.4 SUBMITTALS
A. Prior to first application for payment, submit proposed schedule of values to the Engineer.
   1. Meet with the Engineer and determine additional data, if any, required to be submitted.
   2. Secure the Engineer’s approval of the schedule of values prior to submitting first application for payment.
   3. A revised schedule of values shall be required after execution of a change order.

PART 2 - PRODUCTS

2.1 ORGANIZATION
A. The schedule of values shall be organized and titled under the standard CSI divisions. The contractor may provide additional sub-categories under these divisions as necessary for tracking of sub-contract costs, subject to approval by the Engineer. Example below.
**Division 7 - Thermal and Moisture Protection**

Roofs
- Roof Structure of Steel Fram
- Canopies
- Roof Covers
- Fireproofing

**Division 8 - Doors and Windows**

Doors
- Wood Doors
- Hollow Metal Doors
- Hardware

**Division 9 - Finishes**

Floors
- Quarry and Hard Tile
- Vinyl Tile
- Terrazzo and Resinous Flooring
- Carpet
- Ceramic Tile
- Hardwood

**Division 22 - Plumbing**

Fixtures
- Piping
- Piping Insulation
- Water Heaters

**Division 23 - Heating and AC**

Controls
- A/C Systems (over 20 tons)
- A/C Systems (over 5 less than 20 tons)
- A/C Systems (Less than 5 tons)
- Duct Work
- Piping
- Insulation
- Composite system-Heating, Ventilating and A/C
- Heat Pump System
- Chiller
Division 26 - Electrical
  Conduit and Wiring
  Fixtures
  Switchgear

Division 28 - Electronic Safety and Security
  Fire Alarm System
  **If it is an alarm system - need to specify this
  and not just indicate fire protection**
SECTION 013100 - PROJECT MEETINGS AND COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: To enable orderly review during progress of the work, and to provide for systematic discussion of problems, the Contractor shall conduct project meetings throughout the construction period. Meeting times and dates shall be set at the Pre-construction conference with the Owner’s Representative and Engineer present.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these specifications.

2. The Contractor’s relations with his subcontractors and material suppliers, and discussions relative thereto, are the Contractor’s responsibility and normally are not part of the project meetings content.

1.2 QUALITY ASSURANCE

A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit the Contractor to solutions agreed upon in the project meetings.

1.3 SUBMITTALS

A. Agenda items: To the maximum extent practicable, advise the Owner’s representative at least 24 hours in advance of project meetings regarding items to be added to the agenda.

B. Minutes:

1. The Contractor will compile minutes of each project meeting and will furnish copies to the Owner, Architect/Engineer, and Subcontractors.

2. Recipients of copies may make and distribute such other copies as they wish. Meeting minutes shall include a complete synopsis of all discussions, decisions, and/or problems being encountered on the project, as well as an update of the schedule.

PART 2 - PRODUCTS

NO PRODUCTS ARE REQUIRED IN THIS SECTION.

PART 3 - EXECUTION

3.1 MEETING SCHEDULE

A. Except as noted below for Preconstruction Meeting, project meetings will be held weekly.
3.2 MEETING LOCATION

A. The Contractor will establish meeting location. To the maximum extent practicable, meetings will be held at the job site.

3.3 PRECONSTRUCTION MEETING

A. The pre-construction meeting shall be conducted by the agency’s Project Representative and the Engineer. Other attendees should include the agency’s construction project manager (if assigned), construction inspectors, the general contractor, major sub-contractors, and the OSE Project Manager. The Engineer shall take minutes of the meeting and provide all attendees with a copy of the items discussed.

B. The agency shall give the OSE Project Manager a minimum of seven (7) days notice of the date, time, and place of any pre-construction meeting.

C. Items for discussion during the pre-construction meeting are provided in the following Table:

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PRE-CONSTRUCTION CONFERENCE ITEM</th>
<th>USER COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Project organizational structure and chain of command;</td>
<td></td>
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<tr>
<td>2.</td>
<td>Schedule of values, schedule of completion;</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Schedule of progress meetings;</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Project work schedule, normal working hours, normal work week;</td>
<td></td>
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<tr>
<td>5.</td>
<td>Required notice for scheduling overtime, outages, interruptions;</td>
<td></td>
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<tr>
<td>6.</td>
<td>Safety issues - general and special;</td>
<td></td>
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<tr>
<td>7.</td>
<td>Temporary and permanent utilities;</td>
<td></td>
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<tr>
<td>8.</td>
<td>Security, keys, fencing, site access, limited access to certain areas;</td>
<td></td>
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<tr>
<td>9.</td>
<td>Project sign;</td>
<td></td>
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<tr>
<td>10.</td>
<td>Designated parking areas, delivery areas;</td>
<td></td>
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<tr>
<td>11.</td>
<td>Designated storage areas, bonded storage, security;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
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<td>---</td>
<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>12.</td>
<td>Designated toilets, break areas, vending areas, smoking areas;</td>
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<tr>
<td>13.</td>
<td>Daily clean-up, trash removal, dumpster, trash areas;</td>
<td></td>
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<tr>
<td>14.</td>
<td>Submittals, shop drawings, testing, reports, approval process;</td>
<td></td>
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<tr>
<td>15.</td>
<td>Required permits, licenses, local inspections, testing;</td>
<td></td>
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<tr>
<td>16.</td>
<td>Demolition items to be salvaged for agency, if any, notification, storage area;</td>
<td></td>
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<tr>
<td>17.</td>
<td>Requirement to locate utilities prior to excavation;</td>
<td></td>
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<td>18.</td>
<td>Agency furnished equipment, rough-in, trim;</td>
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<td>19.</td>
<td>Application for Payment in the form of AIA G702, payment dates, payment for stored materials in bonded storage;</td>
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<tr>
<td>20.</td>
<td>Prompt payments to contractors in 21 days, subcontractors 7 days thereafter;</td>
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<tr>
<td>21.</td>
<td>Timely notification by the Contractor in writing to the A/E of any alleged agency-caused delay and the estimated cost of the delay;</td>
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<td>22.</td>
<td>Additional weather related time extensions monthly;</td>
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<td>23.</td>
<td>Change orders, change directives, clarifications;</td>
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<tr>
<td>24.</td>
<td>Required inspections by A/E, agency, and inspectors (where applicable),</td>
<td></td>
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<tr>
<td>25.</td>
<td>Use of OSE Inspection logs and maintaining logs &amp; reports on site; Inspection report routing – direct distribution rather than by link</td>
<td></td>
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<tr>
<td>26.</td>
<td>Substantial Completion inspection, and notification procedure</td>
<td></td>
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<tr>
<td>27.</td>
<td>Substantial Completion certification by the A/E;</td>
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<tr>
<td>28.</td>
<td>Occupancy – Full, Temporary or Partial;</td>
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<tr>
<td>29.</td>
<td>Assessment of liquidated damages;</td>
<td></td>
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<tr>
<td>30.</td>
<td>Required Operation and Maintenance Manuals (provide prior to Final Completion);</td>
<td></td>
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<tr>
<td>31.</td>
<td>Instruction and training of maintenance personnel (provide prior to move-in/occupancy)</td>
<td></td>
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<tr>
<td>32.</td>
<td>Warranties, manufacturer start-up, guarantees (provide prior to Final Completion)</td>
<td></td>
</tr>
</tbody>
</table>
33. Record drawings, as built drawings;

34. Final Completion inspection, punch list;

35. Retainage withheld; consent of surety company before release of retainage;

36. One-year inspection (A/E to inspect the facility 10 months after Substantial Completion).

3.4 PROJECT MEETINGS

A. Attendance

1. To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of work.
2. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the work is involved.

B. Minimum agenda:

1. Review revise as necessary, and approve discussions, agreements and understanding of the previous meeting.
2. Review progress of the work since last meeting, including status of submittals for approval.
3. Identify problems that impede planned progress.
4. Develop corrective measures and procedures to regain planned schedule.
5. Complete other current business.

END OF SECTION 013100
SECTION 013200 - CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To assure adequate planning and execution of the work and aid in completing construction within the number of calendar days allowed in the Contract, and to assist the Architect/Engineer in evaluating progress of the Work, prepare & maintain the schedules and reports described in this Section.

B. Documents affecting scheduling include, but are not limited to, General Conditions, Supplementary Conditions, and Sections in Division 01 of these specifications.

1.2 DEFINITIONS

A. "Day", as used throughout the Contract unless otherwise stated, means "calendar day".

1.3 QUALITY ASSURANCE

A. Employ a scheduler who is thoroughly trained and experienced in compiling construction schedule, and in preparing and issuing periodic updates and reports as required. The scheduler shall be actively and regularly engaged in the practice of scheduling construction projects. The cost of providing the initial schedule and biweekly updates shall be part of the base bid.

B. Perform data preparation, analysis, charting, and updating in accordance with standards approved by the Architect/Engineer.

1.4 SUBMITTALS

A. Comply with pertinent provisions of Submittals, section 013300.

B. Construction schedule: Within 30 calendar days after the Contractor has received the Notice to Proceed, submit one reproducible copy of a construction schedule.

C. Periodic revisions and reports: Submit one copy of the construction schedule updated along with the monthly payment request.

PART 2 - PRODUCTS

2.1 CONSTRUCTION ANALYSIS

A. Graphically show by bar-chart the order and interdependence of all activities necessary to complete the work, and the sequence in which each activity is to be accomplished, as planned by the Contractor and his project field superintendent in coordination with all subcontractors whose work is shown on the diagram.
PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. As soon as practicable after receipt of Notice to Proceed, complete the construction analysis in preliminary form, meet with the Architect/Engineer, review contents of the proposed construction schedule, and make all revisions agreed upon.

3.2 PERIODIC REVISIONS AND REPORTS

A. As required under Paragraph 1.04-C above, update the approved construction schedule along with each payment certificate. Indicate "actual" progress in percent completion for each activity in blank space provided below listed activity and provide written narrative summary of revisions causing delay in the program, and an explanation of corrective actions taken or proposed.

END OF SECTION 013200
SECTION 013300 - SUBMITTALS

PART 1 - GENERAL

1.1 COORDINATION WITH OTHER SECTIONS OF CONTRACT
   
   A. Refer to other sections of the contract specifications for detailed submittal requirements for each Section. At a minimum, submittals must meet the requirements in this Section. More detailed submittals may be required by other Sections. The submittal must meet the most stringent of the requirements.

1.2 SUBMITTALS
   
   A. Submit shop drawings, product data as required to the Owner in sufficient number to allow the Owner to retain two copies. Make all submittals at one time. Make all submittals no later than two weeks after receipt of the “Notice to Proceed.” Contact Engineer in advance if submittal will not be within two weeks of receipt of “Notice to Proceed.”
   
   B. Shop drawings shall be submitted in a clear and thorough manner. Details shall be identified by reference to sheets and details, schedules and room numbers shown on the Contract Drawings and Division of the specification and indexed accordingly.
   
   C. Product Data shall clearly identify pertinent products and models on each copy. Show performance characteristics, capacities, dimensions, clearances, wiring, piping diagrams, and controls as required. Modify manufacturer’s standard schematic drawings and diagrams to provide information specifically applicable to the work.
   
   D. Samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product.

1.3 CONTRACTOR RESPONSIBILITIES
   
   A. Review Shop Drawings, Product Data and Samples prior to submission.
   
   B. Determine and Verify:
      
      1. Field measurements
      2. Field construction criteria
      3. Catalog numbers and similar data
      4. Conformance with specifications
   
   C. Coordinate each item submitted with requirements of the work and of the Contract Documents.
   
   D. Notify the Owner in writing, at time of submission, of any deviations in the submittals from requirements of the contract Documents.
   
   E. Do not begin fabrication (or any work that requires submittals) until submittals are returned with the Owner’s approval.
1.4 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor.

B. Number of submittals required:
   1. Shop Drawings: Submit one reproducible transparency and one opaque reproduction.
   2. Product Data: Submit the number of copies that the Contractor requires, plus two which will be retained by the Owner.
   3. Samples: Submit the number stated in each specification Division.

C. Submittals shall contain:
   1. The date of submission and the dates of any previous submissions.
   2. The project title and number.
   4. The names of:
      a. Contractor
      b. Supplier
      c. Manufacturer
   5. Identification of the product, with the specification Division number.
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the Work or materials.
   8. Applicable standards, such as ASTM or Federal Specification numbers.
   10. Identification of revisions on re-submittals.
   11. An 8 in. x 3 in. Blank space for Contractor and Owner stamps.
   12. Contractor’s stamp, initialed or signed, certifying review of the submittal. Stamp and signature indicate that the following have been reviewed:
      • verification of products
      • field measurements
      • field construction criteria
      • coordination of the information within the submittal with requirements of the Work and Drawings
      • coordination of the information within the submittal with requirements of Contract Documents.

1.5 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals required by the Owner and resubmit until approved.

B. Shop Drawings and Product Data:
   1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
1.6 DISTRIBUTION: Distribute reproductions of Shop Drawings and copies of product Data that carry the Owner stamp of approval to:

A. Job site file.
B. Record Documents file.
C. Other affected contractors.
D. Subcontractors.
E. Supplier or Fabricator.

1.7 OWNER DUTIES

A. Review submittals with reasonable promptness and in accordance with approved schedule.
B. Affix stamp and initials or signature, and indicate requirements for re-submittal, or approval of submittals.
C. Return submittals to Contractor for distribution, or for resubmission.
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor’s quality-control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities have jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient projection capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

F. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner’s responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephones numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor’s responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor’s responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Document are Contractor’s responsibility.

5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer’s Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor’s responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.

5. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspection, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substances and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor’s responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000
Statement of Special Inspections

Medical University of South Carolina

Project: Storm Eye Institute Chiller Replacement – Phase II

Permit Number:

Project Location:

Owner/Address: City Zip:

Registered Design Professional

In Responsible Charge: Christopher Gilger, PE

Address: 1226 Yeamans Hall Rd

City: Hanahan State: SC Zip: 29410 Phone: 843-566-0161

E-mail: chrisg@adcengineering.com

This statement of Special Inspections attached is submitted as a condition for permit issuance in accordance with Section 1704 of the 2015 International Building Code. It includes a Schedule of Special Inspection Services applicable to the above referenced project as well as the identity of the individuals, agencies, or firms (completed by others) intended to be retained for conducting these inspections. The Special Inspection Coordinator (Registered Design Professional In Charge of Administering Special Inspections) shall keep records of all inspections and shall furnish interim inspection reports to the Engineer of Record (Registered Design Professional in Responsible Charge of Construction Documents) at a frequency agreed upon by the permit applicant and Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor and the Engineer of Record for correction. If the discrepancies are not corrected, the Special Inspection Coordinator shall bring the discrepancies to the attention of the Building Official and the Engineer of Record prior to the completion of that phase of work. The Special Inspection Coordinator shall submit a Final Report of Special Inspections to the building official at the conclusion of the project and before a certificate of occupancy will be issued.

Statement of Special Inspections encompass the following disciplines:

☐ Structural ☐ Mechanical/Electrical/Plumbing
☐ Architectural ☐ Other: 

Prepared by:

Christopher Gilger, PE

Type or Print Name

Signature

September 24, 2018

Date

Preparer’s Seal and Signature Required

To be filled out by the jurisdiction and returned to applicant

Building Official’s Acceptance of Special Inspections

☐ ☐ ☐ ☐

Frequency of Interim reports: Monthly Bi-Monthly Upon Completion Per Attached Schedule

Signature Date TMS Permit Number
This Statement of Special Inspections includes the following building systems:

- Soils and Foundations
- Cast-in-Place Concrete
- Precast Concrete
- Masonry
- Structural Steel
- Cold-Formed Steel Framing
- Wood Construction
- Architectural Components
- Mechanical & Electrical Systems
- Storage Racks
- Spray Fire Resistant Material
- Special Cases

<table>
<thead>
<tr>
<th>Special Inspection Agencies</th>
<th>Firm</th>
<th>Address, Telephone, e-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Special Inspection Coordinator (Registered Professional in Responsible Charge of Administering Special Inspections)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Inspector</td>
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<td>3. Inspector</td>
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<tr>
<td>4. Testing Agency</td>
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<tr>
<td>5. Testing Agency</td>
<td></td>
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<tr>
<td>6. Other</td>
<td></td>
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</tbody>
</table>

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner’s Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.
Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official and shall be in accordance with the building code or any particular requirements of the specifications or material specific referenced standards. The credentials of all Inspectors and testing technicians shall be provided if requested.

Special Inspection Definitions

Continuous Special Inspection - Special inspection by the special inspector who is present when and where the work to be inspected is being performed.

Periodic Special Inspection - Special inspection by the special inspector who is intermittently present where the work to be inspected has been or is being performed. Unless noted otherwise 100% of the work designated for inspection shall be inspected.
<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1704.2.5 Special Inspection of Fabricated Items</strong></td>
<td></td>
</tr>
<tr>
<td>Metal Building Fabrication: Verify Fabrication/Quality Control Procedures</td>
<td>Verify Metal Building Fabricator is IAS AC472 Accredited</td>
</tr>
<tr>
<td>Structural Steel Fabrication: Verify Fabrication/Quality Control Procedures</td>
<td>Verify Steel Fabrication plant is AISC certified</td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
<td>SCOPE OF SERVICE</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>1705.1.1 Special Cases</strong></td>
<td></td>
</tr>
<tr>
<td>Post Installed Anchors</td>
<td></td>
</tr>
<tr>
<td>Installer Qualifications</td>
<td>Review installer training records to confirm they have received manufacturer training per the contract documents</td>
</tr>
<tr>
<td>Anchor Installation</td>
<td>Continuously inspect complete process of anchor installation in accordance with requirements of approved ICC ESR report. As minimum review installation procedures including drill bit type, drilling methods, hole preparation and cleaning, spacing, edge distance, embedment depth, adhesive installation, rod installation, curing time, and anchor torque to ensure compliance with manufacturer’s instructions and construction documents. (All anchor holes must be inspected during drilling, all anchor holes must be inspected prior to anchor installation, all anchors shall be inspected at final application of required torque)</td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
<td>SCOPE OF SERVICE</td>
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</tr>
<tr>
<td><strong>1705.2.1 Structural Steel</strong></td>
<td>Periodically review fabricator’s source quality assurance inspection and test reports to ensure all inspection and testing is being completed as required and appropriate standards are being met. <em>(100% rate for all source quality control report submittals.)</em></td>
</tr>
<tr>
<td>Review fabricator’s source quality assurance inspection and testing report submittals</td>
<td>Periodically confirm that welding procedure specifications (WPS) are available and on site for type and configuration of weld being completed. <em>(100% rate for each type and configuration of weld immediately prior to the weld being completed)</em></td>
</tr>
<tr>
<td></td>
<td>Periodically confirm manufacturers certifications are available and on site for all welding consumables. <em>(100% rate for each type of consumable immediately prior to initial use of each consumable)</em></td>
</tr>
<tr>
<td></td>
<td>Periodically inspect material identification (type/grade)</td>
</tr>
<tr>
<td></td>
<td>Periodically confirm that a welder identification system is in place for field welding and that the system is being used <em>(confirm system is in place prior to welding and 100% confirmation of system usage during welding inspection)</em></td>
</tr>
<tr>
<td></td>
<td>Periodically inspect fit-up of groove welds including joint preparation, dimensions, cleanliness, tacking, backing type and backing fit <em>(100% inspection rate of all groove weld joints immediately prior to completing weld)</em></td>
</tr>
<tr>
<td></td>
<td>Periodically inspect configuration and finish of weld access holes <em>(100% inspection rate of all weld access holes immediately prior to completing associated weld)</em></td>
</tr>
<tr>
<td>Conduct Inspections prior to field welding in accordance with AISC 360 Table N5.4-1</td>
<td>Periodically inspect fit-up of fillet welds including dimensions, cleanliness, and tacking <em>(Random inspection rate for general conformance with a minimum rate of once weekly during steel erection)</em></td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
<td>SCOPE OF SERVICE</td>
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<tr>
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</tr>
<tr>
<td>1705.2.1 Structural Steel (Continued)</td>
<td>Periodically confirm that welders are qualified for welds which they are completing and they possess a valid welding certificate for that weld type and configuration. (Random inspection rate for general conformance with a minimum rate of once weekly during welding operations) Periodically inspect control and handling of welding consumables including packaging and exposure control. (Random inspection rate for general conformance with a minimum rate of once weekly during welding operations) Periodically confirm that no welding is occurring over cracked tack welds. (Random inspection rate for general conformance with a minimum rate of once weekly during welding operations) Periodically confirm that environmental conditions are acceptable including wind speed limits, precipitation and temperature. (Random inspection rate for general conformance with a minimum rate of once weekly during welding operations) Periodically/Continuously confirm that weld procedure specifications (WPS’s) are being followed including setlings of welding equipment, travel speed, selected welding materials, shielding gas type and flow rate, preheat applied, interpass temperature maintained, and proper position. (Continuously inspect for groove welds, multi-pass welds, or welds greater than 5/16”. Periodically inspect all other welds a minimum rate of once weekly during welding operations) Periodically/Continuously confirm welding techniques including interpass and final cleaning, each pass with profile limitations, each pass meets quality requirements. (Continuously inspect for groove welds, multi-pass welds, or welds greater than 5/16”. Periodically inspect all other welds a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Conduct inspections during field welding in accordance with AISC 360-10 Table N5.4-2</td>
<td></td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
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<tr>
<td><strong>1705.2.1 Structural Steel (Continued)</strong></td>
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<tr>
<th>SCOPE OF SERVICE</th>
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<tbody>
<tr>
<td>Periodically confirm that welds have been cleaned. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically confirm weld size, length and location. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically confirm weld meets visual acceptance criteria including crack prohibition, weld/base-metal fusion, crater cross section, weld profiles, weld size, undercut, and porosity. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically inspect arc strikes. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically inspect k-area for cracks within 3” of welds when welding has been performed in k-area. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically confirm backing and weld tabs have been removed where required. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically inspect repair activities. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically document acceptance or rejection of welded joint or member. (100% inspection rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Periodically ultrasonically test all complete joint penetration welds (CJP) in accordance with AWS D1.1 (100% inspection rate)</td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
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<tr>
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</tbody>
</table>
| **1705.2.1 Structural Steel (Continued)** | **Periodically** confirm manufacturers certifications are available each type of fastener material.  
(100% rate for each type of fastener material immediately prior to initial use of each type of material) |
| | **Periodically** confirm fasteners are marked in accordance with ASTM Standard.  
(Random inspection rate for general conformance with a minimum rate of once weekly during bolting operations) |
| | **Periodically** confirm proper fasteners are selected for the joint detail including grade, type, and bolt length (if threads are to be excluded from shear plane).  
(100% inspection rate) |
| | **Periodically/Continuously** confirm proper bolting procedure selected for joint detail.  
(100% inspection rate, continuous inspection for slip critical joints, periodic inspection for all other joints with random inspection with a minimum rate of once weekly during bolting operations) |
| | **Periodically/Continuously** inspect connection elements, including appropriate faying surface condition and hole preparation meet applicable requirements.  
(continuous inspection for slip critical joints with 100% inspection rate, periodic inspection for all other joints with random inspection with a minimum rate of once weekly during bolting operations) |
| | **Periodically/Continuously** Conduct Preinstallation verification testing by installation personnel and document for fastener assemblies and methods used for slip critical joints.  
(Periodically, one time per installer for turn of nut, direct tension indicators, or tension controlled bolts. Periodically, once daily for calibrated wrench without match marking) |
| | **Periodically** confirm proper storage for bolts, nuts, washers and other fastener components.  
(Random inspection rate for general conformance with a minimum rate of once weekly during bolting operations) |
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<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
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<tbody>
<tr>
<td><strong>1705.2.1 Structural Steel (Continued)</strong></td>
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</tr>
<tr>
<td>Conduct Inspections during high strength bolting in accordance with AISC 360-10 Table N5.6-2</td>
<td>Periodically/Continuously confirm fastener assemblies, of suitable conditions, placed in all holes and washers (if required) are positioned as required. (100% inspection rate, continuous inspection for slip critical joints, periodic inspection for all other joints with random inspection with a minimum rate of once weekly during bolting operations) Continuously confirm joints are brought to the snug-tight condition prior to pretensioning operation (100% inspection rate, continuous inspection for slip critical joints) Continuously component not turned by the wrench is prevented from rotating (100% inspection rate, continuous inspection for slip critical joints) Periodically/Continuously confirm fasteners are pretensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges (100% inspection rate, continuous inspection for slip critical joints pretensioned with calibrated wrench or turn-of-the-nut without match marking. Periodic inspection for slip critical joints pretensioned with tension controlled bolts, direct tension indicators, or turn-of-the-nut with match marking</td>
</tr>
<tr>
<td>Conduct Inspections after high strength bolting in accordance with AISC 360-10 Table N5.6-3</td>
<td>Periodically document acceptance or rejection of bolted connections. (100% rate with a minimum rate of once weekly during welding operations)</td>
</tr>
<tr>
<td>Other inspection Task</td>
<td>Periodically inspect placement of anchor rods and other embedded items prior to concrete/masonry grout placement operations. Confirm diameter, grade, type and length of the anchor rod or embedded item, and the extent or depth of embedment into concrete/masonry grout. (100% inspection rate immediately prior to concrete/masonry grout placement operation) Periodically inspect the steel frame to verify compliance with the details shown on the construction documents including braces, stiffeners, member locations, and proper application of joint details at each connection. (100% inspection rate with a minimum rate of once weekly during steel erection operations)</td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
<td>SCOPE OF SERVICE</td>
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</tr>
<tr>
<td><strong>1705.2.2 Cold Formed Steel Deck</strong></td>
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</tr>
</tbody>
</table>
| Conduct inspections prior to deck placement in accordance with SDI QA/QC-2011 Table 1.1 | **Periodically** verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness, *(100% inspection rate prior to deck installation)*  
Document acceptance or rejection of deck and deck accessories |
| Conduct inspections after deck placement in accordance with SDI QA/QC-2011 Table 1.2 | **Periodically** verify compliance of deck and all deck accessories installation with construction documents. *(100% inspection rate, with a minimum rate of once weekly during deck installation operations)*  
**Periodically** verify deck materials are represented by mill certifications that comply with construction documents. *(100% inspection rate)*  
Document acceptance or rejection of deck and deck accessories |
| Conduct inspections prior to welding in accordance with SDI QA/QC-2011 Table 1.3 | **Periodically** confirm that welding procedure specifications (WPS) are available and on site for type and configuration of weld being completed. *(100% rate for each type and configuration of weld immediately prior to the weld being completed)*  
**Periodically** confirm manufacturers certifications are available and on site for all welding consumables. *(100% rate for each type of consumable immediately prior to initial use of each consumable)*  
**Periodically** inspect material identification (type/grade)  
**Periodically** inspect welding equipment to insure equipment is functional and is of type required by WPS’s |
<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
</tr>
</thead>
</table>
| **1705.2.2 Cold Formed Steel Deck (Continued)**                                   | **Periodically** confirm that welders are qualified for welds which they are completing and they possess a valid welding certificate for that weld type and configuration *(Random inspection rate for general conformance with a minimum rate of once weekly during welding operations)*  
 **Periodically** inspect control and handling of welding consumables including packaging and exposure control. *(Random inspection rate for general conformance with a minimum rate of once weekly during welding operations)*  
 **Periodically/Continuously** confirm that weld procedure specifications *(WPS’s)* are being followed including settings of welding equipment, travel speed, selected welding materials, shielding gas type and flow rate, and proper position. *(Periodically inspect all other welds a minimum rate of once weekly during welding operations)*  
 **Periodically** confirm that environmental conditions are acceptable including wind speed limits, precipitation and temperature. *(Random inspection rate for general conformance with a minimum rate of once weekly during welding operations)*  
 **Periodically** confirm size and location of welds, including support, side-lap and perimeter welds. *(100% inspection rate with a minimum rate of once weekly during welding operations)*  
 **Periodically** confirm welds meet visual acceptance criteria *(100% inspection rate with a minimum rate of once weekly during welding operations)*  
 **Periodically** verify repair activities *(100% inspection rate with a minimum rate of once weekly during welding operations)*  
 Document acceptance or rejection of welds                                                                                                                                                                                                                                 |
| **Conduct inspections during welding in accordance with SDI QA/QC-2011 Table 1.4** |                                                                                                                                                                                                                                                                                                                                                      |
| **Conduct inspections after welding in accordance with SDI QA/QC-2011 Table 1.5** |                                                                                                                                                                                                                                                                                                                                                      |
| **Conduct inspections prior to mechanical fastening accordance with SDI QA/QC-2011 Table 1.6** | **Periodically** confirm that manufacturer’s installation instructions are available for each type of mechanical fastener. *(100% rate for each type and configuration of fastener prior to fastener being installed)*  
 **Periodically** confirm that proper tools are available for the installation of each fastener. *(100% rate for each type and configuration of fastener prior to fastener being installed)*  
 **Periodically** confirm proper storage of mechanical fasteners *(100% inspection rate with a minimum rate of once weekly during fastening operations)*                                                                                                                                 |
<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
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</thead>
</table>
| **1705.2.2 Cold Formed Steel Deck (Continued)**                                   | **Periodically** confirm that fasteners are positioned as required *(100% inspection rate with a minimum rate of once weekly during fastening operations)*  
**Periodically** confirm that fasteners are installed in accordance with manufacturer’s instructions *(100% inspection rate with a minimum rate of once weekly during fastening operations)*  
**Periodically** confirm spacing, type and installation of support fasteners. *(100% inspection rate with a minimum rate of once weekly during fastening operations)*  
**Periodically** confirm spacing, type and installation of sidelap fasteners. *(100% inspection rate with a minimum rate of once weekly during fastening operations)*  
**Periodically** confirm spacing, type and installation of perimeter fasteners. *(100% inspection rate with a minimum rate of once weekly during fastening operations)*  
Verify repair activities  
Document acceptance or rejection of mechanical fasteners |
<p>| Conduct inspections during mechanical fastening in accordance with SDI QA/QC-2011 Table 1.7 |                                                                                                                                                                                                                   |
| Conduct inspections after mechanically fastening in accordance with SDI QA/QC-2011 Table 1.8 |                                                                                                                                                                                                                   |</p>
<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
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</thead>
<tbody>
<tr>
<td><strong>1705.3 Concrete Construction</strong></td>
<td></td>
</tr>
<tr>
<td>Inspection of reinforcing steel, including placement</td>
<td>Periodically inspect reinforcing steel placement in accordance with contract documents and approved shop drawings to confirm size, spacing, cover, positioning, bends, grade, laps, supports and anchorage. <em>(100% inspection rate immediately prior to placing concrete)</em></td>
</tr>
</tbody>
</table>
| Inspection of anchors cast in concrete | Periodically inspect size, positioning, embedment, and projection of anchor rods is in accordance with contract documents and approved shop drawings. *(100% inspection rate immediately prior to placing concrete)*  
Continuously inspect concrete placement and consolidation around anchors. *(100% inspection rate during concrete placement)* |
| Inspection of anchors post-installed in hardened concrete members. | Review installer training records to confirm they have received manufacturer training per the contract documents  
Continuously inspect complete process of anchor installation in accordance with requirements of approved ICC ESR report. As minimum review installation procedures including drill bit type, drilling methods, hole preparation and cleaning, spacing, edge distance, embedment depth, adhesive installation, rod installation, curing time, and anchor torque to ensure compliance with manufacturer’s instructions and construction documents. *(All anchor holes must be inspected during drilling, all anchor holes must be inspected prior to anchor installation, all anchors shall be inspected at final application of required torque)* |
| Verifying use of required design mix | Periodically review batch tickets to confirm the appropriate approved mix design is being used for the location in which concrete is being placed *(100% review rate during concrete placement)*  
Periodically verify that water added at the site does not exceed that allowed by the batch ticket *(100% inspection rate during concrete placement)* |
### 1705.3 Concrete Construction (Continued)

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample fresh concrete to fabricate specimens for strength tests, perform fresh unit weight density, slump and air content tests, and determine the temperature of concrete</td>
<td>Continuously test concrete compressive strength (ASTM C31 &amp; C39), fresh unit weight density (ASTM C138), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064). Samples for preparing unit weight density specimens and measuring air content shall be obtained at the point of placement. Slump measurements are for reference only and shall not be a basis of rejection. Threshold for fresh unit weight density shall be in accordance with approved mix design submittals. <em>(Frequency of sampling and testing as required by section 5.6.2 of ACI 318)</em></td>
</tr>
<tr>
<td>Sample fresh concrete to fabricate specimens for equilibrium unit weight testing of lightweight concrete</td>
<td>Continuously test concrete unit weight density of lightweight concrete per (ASTM C31 &amp; C567). Samples for preparing equilibrium unit weight density specimens shall be obtained at the point of placement. <em>(Frequency of sampling and testing as required by section 5.6.2 of ACI 318)</em></td>
</tr>
<tr>
<td>Inspection of concrete for proper application techniques</td>
<td>Continuously inspect concrete placement techniques to confirm compliance with sections 5.9 and 5.10 of ACI 318.</td>
</tr>
<tr>
<td>Inspection for maintenance of specified curing temperatures and techniques</td>
<td>Periodically inspection curing temperatures and techniques to insure compliance with contract documents and sections 5.11-5.13 of ACI 318</td>
</tr>
<tr>
<td>MATERIAL / ACTIVITY</td>
<td>SCOPE OF SERVICE</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>1705.11 Special Inspections for Wind Resistance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1705.11.1 Structural Wood</strong></td>
<td>Periodically inspect nailing, bolting, anchoring and other fastening of components of the main wind force resisting system. Inspection shall include wood shear walls, wood diaphragms, drag struts/collectors, chords, braces, shear panels and hold downs. <strong>(Random inspection rate for general conformance with a minimum rate of once weekly during construction of seismic force resisting system)</strong></td>
</tr>
<tr>
<td><strong>1705.11.2 Cold Formed Steel Light Framed Construction</strong></td>
<td>Periodically inspect screw attachment, bolting, anchoring and other fastening of components of the main wind force resisting system. Inspection shall include shear walls, wood diaphragms, drag struts/collectors, chords, braces, shear panels and hold downs. <strong>(Random inspection rate for general conformance with a minimum rate of once weekly during construction of seismic force resisting system)</strong></td>
</tr>
<tr>
<td><strong>1705.11.3 Wind Resisting Components</strong></td>
<td>Periodically inspect the installation of Roof Cladding is in accordance with approved submittals and manufacturer’s installation requirements. <strong>(Random inspection rate for general conformance with a minimum rate of once weekly during roof cladding installation)</strong></td>
</tr>
<tr>
<td></td>
<td>Periodically inspect the installation of Wall Cladding is in accordance with approved submittals and manufacturer’s installation requirements. <strong>(Random inspection rate for general conformance with a minimum rate of once weekly during wall cladding installation)</strong></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
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</thead>
<tbody>
<tr>
<td><strong>1705.12 Special Inspections for Seismic Resistance</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **1705.12.1 Structural Steel**  
(Seismic Force Resisting System) | Periodically review fabricator’s source quality assurance inspection and test reports to ensure all inspection and testing is being completed as required and appropriate standards are being met.  
(100% rate for all source quality control report submittals.)  
Special inspector shall submit a written quality assurance plan for field inspection in accordance with AISC 341-10 Chapter J3  
Inspect field welding of Seismic Force Resisting System Weld Inspection in accordance with AISC 341-10 item J6  
Inspect field bolting of Seismic Force Resisting System Bolting Inspection in accordance with AISC 341-10 item J7  
Inspect other steel structure items in accordance with AISC 341-10 item J8  
Inspect field construction of composite structures in accordance with AISC 341-10 item J9  
Inspect field fabrication of steel piles in accordance with AISC 341-10 item J10 |
| **1705.12.3 Cold Formed Steel Light Frame Construction**  
(Seismic Force Resisting System) | Periodically inspect screw attachment, bolting, anchoring and other fastening of components of the seismic force resisting system. Inspection shall include shear walls, wood diaphragms, drag struts/collectors, chords, braces, shear panels and hold downs.  
(Random inspection rate for general conformance with a minimum rate of once weekly during construction of seismic force resisting system) |
| **1705.12.5 Architectural Components** | Periodically inspect the erection and fastening of exterior wall cladding to ensure compliance with specifications, approved submittals and manufacturer’s installation requirements.  
(Random inspection rate for general conformance with a minimum rate of once weekly during cladding installation)  
Periodically inspect the erection and fastening of interior and exterior veneers to ensure compliance with specifications, approved submittals and manufacturer’s installation requirements.  
(Random inspection rate for general conformance with a minimum rate of twice weekly during cladding installation)  
Periodically inspect installation of interior and exterior nonbearing walls to ensure installation is in accordance with construction documents, specifications, and approved shop drawing submittals and/or manufacturer’s instructions. Inspection shall include verifications of fastening of wall components and wall anchorages including number, type and spacing of fasteners as well as confirmation that installed connections allow for specified vertical and/or drift deflections.  
(100% inspection rate with a minimum inspection rate of once weekly during nonbearing wall installation.) |
<table>
<thead>
<tr>
<th>MATERIAL / ACTIVITY</th>
<th>SCOPE OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1705.13 Testing and Qualification for Seismic Resistance</strong></td>
<td></td>
</tr>
<tr>
<td>1705.13.2 Structural Steel (Seismic Force Resisting System)</td>
<td>Special inspector shall submit a written quality assurance plan for field testing in accordance with AISC 341-10 Chapter item J6 Test welding of Seismic Force Resisting System in accordance with AISC 341-10 item J6</td>
</tr>
</tbody>
</table>
Contractor’s Statement of Responsibility

Each contractor responsible for the construction of a main wind force or seismic force resisting system, designated, seismic system or a wind or seismic resisting component listed in the statement of special inspections shall submit a Statement of Responsibility. The statement shall be submitted prior to the commencement of work on the system or component.

Project:

Contractor’s Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility:

Contractor’s Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the special requirements contained in the statement of special inspections.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

Signature __________________________ Date __________________________
Fabricator’s Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2.5 of the International Building Code must submit a Fabricator’s Certificate of Compliance at the completion of fabrication.

Project:

Fabricator’s Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the approved construction documents.

________________________________          ______________
Signature                                                           Date

________________________________
Title

Attach copies of fabricator’s certification or building code evaluation service report.
FINAL REPORT OF SPECIAL INSPECTIONS

Project: __________________________________ Application No.: __________________________

Project Location: ________________________________________________________________

Project Owner: _________________________________________________________________

Address: _______________________________________________________________________

SC Registered Design Professional in Responsible Charge: ______________________________

Firm (optional): __________________________________________________________________

License No.: SC __________________ Phone: __________________________ Fax: ______________

Address: _______________________________________________________________________

To the best of my information, knowledge, and belief, the Special Inspections and/or Testing required for this project, and designated for this Agent in the Statement of Special Inspections submitted for permit have been completed in accordance with the contract documents.

Field reports submitted prior to this Final Report of Inspections form a basis for, and are to be considered an integral part of this Final Report. All discrepancies that were outstanding in all of the Field reports have been corrected.

Prepared by: Special Inspection Coordination

Type or print name

Firm (optional)

Signature Date

Individual Seal

Firm Seal
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish, maintain and remove at completion of project, all temporary equipment that is required for the proper execution of work of all trades and is further described in this section of specifications.

B. Related Work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and sections in Division 1 of these specifications.

C. Inspect equipment furnished by subcontractors to insure that equipment complies with requirements of pertinent safety regulations.

D. Maintain temporary facilities and controls in proper and safe condition throughout progress of the work.

PART 2 - PRODUCTS

2.1 CONTRACTORS’ TEMPORARY EQUIPMENT

A. Contractor shall furnish, maintain and remove at completion equipment such as temporary stairs, ladders, ramps, chutes, and like facilities, as required for proper execution of the work.

B. Contractor shall coordinate the provisions of exterior and interior scaffolding required for execution of this work. Such scaffolding shall conform to requirements of authorities having jurisdiction over such work and be maintained in safe condition at all times. Remove when no longer required.

2.2 LIFTING DEVICES AND HOISTING FACILITIES

A. Contractor shall provide, operate, and maintain construction elevators, or cranes as well as other type hoists and hoisting material as may be required for execution of all trades’ work. Such apparatus, equipment and construction shall meet requirements of labor laws and other state or local laws.

2.3 BARRIERS

A. Comply with Federal, State, and Local codes and regulations.

B. Contractor shall provide and maintain bracing, shoring, sheeting, lights (warning and exit), guardrails, barricades, warning signs and other features necessary to adequately protect persons and property. When the need no longer exists remove such protective devices and/or procedures.
2.4 SECURITY ENCLOSURES AND PRECAUTIONS

A. Contractor shall provide all temporary enclosures required for protecting the project from the exterior, for providing passageways, for the protection of openings both exterior and interior and any other location where temporary enclosures and protection may be required.

B. Contractor shall take adequate precautions against fire, keep flammable material at an absolute minimum, and ensure that such material is properly handled and stored.

2.5 TELEPHONE SERVICE

A. Contractor shall provide and maintain a job telephone for the duration of the contract, and shall pay all costs in connection therewith. Toll calls shall be paid for by the party making the call.

2.6 TEMPORARY SANITARY FACILITIES

A. Permanent toilet facilities may be used by the construction personnel upon written permission of the Owner and subject to conditions mutually agreed to in writing.

2.7 TEMPORARY ELECTRICITY

A. The Contractor shall make the necessary arrangements and provide all temporary electrical services and lighting required during construction. Electricity at its source shall be furnished to Contractor by Owner.

2.8 TEMPORARY WATER DURING CONSTRUCTION

A. The contractor shall make arrangements to provide all water required during construction. Water, at source, to be furnished by the Owner.

2.9 ACCESS ROADS AND PARKING AREAS

A. Access to site for delivery of construction equipment and materials shall be made only from locations designated by Owner.

B. Parking of employee and Contractor vehicles on the site shall be limited to area or areas shown on drawings, or where not shown, as approved by Owner. Vehicles illegally parked will be removed from site at the expense of vehicle owner.

2.10 EXISTING BUILDING, NEW CONSTRUCTION SEPARATION

A. Contractor shall provide temporary enclosures to separate work areas from the areas of existing buildings occupied by Owner; to prevent penetration of dust or moisture into occupied areas, to prevent damage to existing equipment, and to protect Owner’s employees and operations from construction work.

B. Use framing and sheet materials which comply with structural and fire rating requirements of applicable codes and standard for temporary partition and ceiling enclosures.
C. Close joints between sheet materials and seal edges and intersections with exiting surfaces, to prevent penetration of dust or moisture.

D. In locations where painting is required, use fire-retardant paint providing a maximum flame spread of 25 when tested under ASTM E 84 or as required by local regulations.

E. Contractor shall provide HEPA filtered negative pressure fans for the purpose of negative pressure in all construction areas in the Hospital. The discharge of the negative pressure fans and filters shall to the outside of the facility and shall not be located within 25 feet of any outside air intakes for hospital HVAC systems. Construction space pressure shall be maintained at negative 0.01” w.c.

F. Contractor shall provide Plywood or equal to insure the proper protection of the existing roofing system and skylights.

G. All unused and stored gas cylinders shall be chained and secured.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES AND CONTROLS

A. Requirements of Regulatory Agencies: Comply with Federal, State and local codes and regulations and with utility company requirements.

B. Materials, General: Materials may be new or used suitable for the intended purpose, must be adequate in capacity for required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

C. The Contractor shall provide all weather protection and temporary cooling as necessary to carry on the work being conducted in the building. Contractor shall maintain properly conditioned working conditions except at specific times approved in advance by the Owner.

D. At completion of the work, when existing equipment has been utilized, the Contractor shall restore all equipment to “Original Condition.” This shall include replacement of all filters, painting, and other servicing required.

3.2 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the work.

B. Remove such temporary facilities and controls as rapidly as progress of the work will permit, or as directed by the Architect/Engineer.

C. At the completion of contract, remove all temporary buildings, sheds and trailers from the site and leave the grounds in the condition specified in other sections.
SECTION 017300 - MISCELLANEOUS CUTTING & PATCHING

PART 1 - GENERAL

1.1 WORK INCLUDED: This Section establishes general requirements pertaining to cutting (including excavating), fitting, and patching of the Work required to:

A. Make the several parts fit properly.

B. Uncover Work to provide for installation, inspection, or both of ill-timed Work.

C. Remove and replace Work not conforming to requirements of the Contract Documents.

D. Remove and replace defective Work.

E. The work of this section shall include all patching of any existing substrate or finish material that is displaced, disturbed, marred or otherwise damaged by the operations of the work of this contract.

F. Patching is herein further understood to include replacement of certain materials that, by their nature, cannot be patched such as resilient base, resilient flooring, etc. This statement primarily concerns itself with finishes in existing areas indicated to remain as part of the finished project.

G. For alterations and additions the repair of all damages made by cutting shall include restoring those surfaces to their original state of finish, including surface texture, design color, etc., unless new finishes are called for. All such repairs shall be performed by personnel trained and proficient in the particular trades involved; i.e., plaster repairs by plasterers, masonry repairs by masons, tile repairs by tile setters, etc. Masonry and tile repairs shall be toothed to maintain bond or pattern. It is the intent of these specifications that all areas requiring repairs shall be restored to a completely finished condition, acceptable to the Owner.

1.2 INSPECTION

A. The contractor shall visit the building, inspect the areas in which work is to be performed and determine for himself the types and extent of finishing materials existing.

B. He shall determine which materials will probably require patching and which will probably require replacement and to what extent.

C. Failure to do so will not relieve him from this responsibility to conform to the requirements of this section.

1.3 RELATED WORK DESCRIBED ELSEWHERE

A. In addition to other requirements specified, upon the Owner’s request, uncover Work to provide for inspection by the Owner of covered Work; and remove samples of installed materials for testing.

B. Do not cut or alter work performed under separate contract without the Owner’s written permission.
1.4 QUALITY ASSURANCE

A. Perform all cutting and patching in strict accordance with pertinent requirements of these Specifications and, in the event no such requirements are determined, in conformance with the Owner’s written direction.

1.5 SUBMITTALS

A. Request for the Owner’s consent:

1. Prior to cutting which affects structural safety, submit written request to the Owner for permission to proceed with cutting.
2. Should conditions of the Work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Owner and secure his written permission prior to proceeding.

B. Notices to the Owner

1. Prior to cutting and patching pursuant to the Owner’s instructions, submit cost estimate to the Owner. Secure the Owner’s approval of cost estimate and type of cost reimbursement before proceeding with cutting and patching.
2. Submit written notice to the Owner designating time the work will be uncovered, to provide for the Owner’s observation.

PART 2 - PRODUCTS

2.1 MATERIALS: For replacement of Work removed, use materials which comply with the pertinent sections of these specifications.

2.2 PAYMENT FOR COSTS: The Owner will reimburse the contractor for cutting and patching performed pursuant the Owner’s written request after claim for such reimbursement is submitted by the Contractor. Perform all other cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

2.3 EXISTING ADJACENT FINISHES

A. The intent of this specification is that all finished surfaces shall present an unblemished finished appearance conforming to existing adjoining materials and colors.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Inspection:

1. Inspect existing conditions, including elements subject to movement or damage during cutting and patching.
2. After uncovering the Work, inspect conditions affecting installation of new Work.
B. Discrepancies:

1. If uncovered conditions are not as anticipated, immediately notify the Owner and secure needed directions.

3.2 PREPARATION PRIOR TO CUTTING: Provide all required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.

3.3 PERFORMANCE: Perform cutting and demolition by methods which will prevent damage to other portions of the Work and will provide proper surfaces to receive installation of repair and new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.

3.4 CONCRETE

A. Concrete shall be patched by cutting out old concrete to remove loose aggregate cement with rectangular sides. Apply approved bonding agent to old concrete to insure firm juncture of new and old.

3.5 CLEAN UP

A. Remove all debris and excess material from the site and legally dispose of it.

END OF SECTION 017300
SECTION 017400 - CLEANING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Throughout the construction period, maintain the buildings and site in a standard of cleanliness as described in this section.

B. Execute cleaning, during progress of the work, and at completion of the work, as required by General Conditions.

C. In addition to standards described in this Section, comply with requirements for cleaning for specific products or work as described in their sections of these specifications.

D. Related Documents: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

B. In addition to the standards described in this Section, comply with pertinent requirements of governmental agencies having jurisdiction.

1.3 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

A. Provide required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

B. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

C. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.

D. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
PART 3 - EXECUTION

3.1 GENERAL PROGRESS CLEANING

A. Retain stored items in an orderly arrangement allowing maximum access, not impeding traffic or drainage, and providing required protection of materials.

B. Do not allow accumulation of scrap, debris, waste material, and other items not further required for construction of this work.

C. At least twice each week, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.

D. Provide adequate storage for all items awaiting removal from the job site, observing requirements for fire protection and protection of the ecology.

3.2 SITE PROGRESS CLEANING

A. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Remove such items to place designated for their storage.

B. Weekly, and more often if necessary, inspect all arrangements of materials stored on site. Restack, tidy, or otherwise service arrangements to meet the requirements of Subparagraph 3.01A above.

C. Maintain the site in a neat and orderly condition at all times.

D. Execute periodic cleaning to keep work, site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

E. Remove waste materials, debris and rubbish from site and dispose of at a legal disposal area away from the site.

3.3 STRUCTURES PROGRESS CLEANING

A. Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris, and waste material. Relocate such items to the place designated for their storage.

B. Weekly and more often if necessary, sweep interior spaces broom clean.

C. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the necessary cleanliness.

3.4 DUST CONTROL

A. Clean interior spaces prior to start of finish painting and continue cleaning on an as-needed basis until painting is finished.
B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.5 FINAL CLEANING

A. Employ skilled workmen for final cleaning.

B. "Clean", for the purpose of this Article, and except as may be specifically provided otherwise, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

C. Remove all traces of soil, grease, mastic, waste materials, adhesives, dust, dirt, stains, smudges, fingerprints, labels, and other foreign materials from sight exposed interior and exterior surfaces.

D. Wash and polish glazing and mirrors.

E. Polish surfaces requiring routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished.

F. Ventilating Systems:
   1. Clean permanent filters and replace disposable filters if units were operated during construction.
   2. Clean ducts, blowers and coils if units were operated without filters during construction.

G. Prior to final completion, or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that entire work is clean.

H. Schedule final cleaning as approved by the Architect/Engineer to enable the Owner to accept a completely clean Project.

I. Owner will assume responsibility for cleaning as of time designated on Certificate of Substantial Completion for Owner's acceptance of Project or portion thereof; except for cleaning required due to execution of punch list items, which shall remain the responsibility of the General Contractor.

END OF SECTION 017400
PART 1 - GENERAL

1.1 WORK INCLUDED

A. To provide an orderly and efficient transfer of the building and building component information to the Owner. Closeout submittals shall consist of the following items:

- Closeout, Warranty and Operation and Maintenance Documents
- Record (as-built) Drawings and Specifications

1.2 QUALITY ASSURANCE

A. One copy of all project closeout submittals shall be forwarded to the Engineer for review and approval prior to forwarding the information required by this section to the Owner. Approval of these documents shall be considered as a pre-requisite for certification of Final Completion.

1.3 MATERIALS LIST

A. Furnish the Owner, three identical copies of a typewritten list showing every manufactured item / material used on the job. Include catalog number, manufacturer’s name and address, distributor’s name and address. Type the lists neatly and index them according to respective sections of specifications.

1.4 CLOSEOUT, WARRANTY, OPERATION AND MAINTENANCE DOCUMENTS

A. Prepare two 3-ring binder titled with the name of the project and date. The binder shall contain, in order, the following information:

1. The Contractor’s name, address, telephone number, fax number and the name of the project manager. Provide contact information for the Contractor’s representative that includes telephone and beeper numbers where the person can be reached for emergency service at all times including nights, weekends, and holidays.
2. The names, addresses, telephone numbers for each major subcontractor.
3. Evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to Certificate of Inspection for Plumbing, Mechanical and Electrical.
4. Certificate of Insurance for products and completed operations.
5. Evidence of payment and release of liens.
6. In order of division, following the order of the section of this specification, all warranty information specifically required by the sections of this specification.
7. In order of division -- following the order of the sections of this specification – catalogs, wiring and control diagrams, manufacturer’s data, maintenance and operation instructions, parts lists on all devices, fixtures, machines, appliances, mechanical and electrical equipment, etc., for permanent maintenance records.
8. Electronic copy of all of the above materials and information in PDF format on CD.
B. Arrange to instruct operating and maintenance personnel of Owner in use and maintenance of mechanical systems and associated control systems and specialty equipment provided under this contract. Submit letter showing when training was held and who attended.

1.5 A/E to complete and submit SE-560 Certificate of Final Completion.

1.6 CONTRACTOR to complete and submit AIA G706 Contractor’s Affidavit of Payment of Debts and Claims that wages, bills for materials and equipment, and other indebtedness connected with the work have been paid.

1.7 CONTRACTOR to complete and submit AIA G706A Contractor’s Affidavit of Release of Liens.

1.8 CONTRACTOR to provide a clean and readable set of project Record Documents showing all deviations or changes in routing, location, or installation procedures made during the course of construction. Deliver Record Documents to Architect/Engineer for Owner. Refer to Section 017839 for details. Accompany this submittal with a transmittal letter, in duplicate, containing:
   - Date
   - Project Title and number
   - Contractor’s name and address
   - Title and number of each Record Document
   - Signature of contractor or his authorized representative

1.9 CONTRACTOR to complete and submit the AIA G707 Consent of Surety to Final Payment.

1.10 CONTRACTOR to provide a certificate in the form of AIA G715 issued by an authorized representative of the contractor’s insurance company certifying completed project insurance coverage as required by the contract documents.

1.11 CONTRACTOR to provide a statement that the Contractor knows of no reason that the completed project insurance will not be renewable to cover the period required by the contract documents.

1.12 RETURN ALL CONTRACTOR’S Identification Badges prior to receipt of final payment.

END OF SECTION 017700
PART 1 - GENERAL

1.1 WORK INCLUDED

A. To provide an orderly and efficient transfer of the building and building component information to the Owner. Closeout submittals shall consist of:

1. Closeout, Warranty & Operation and Maintenance Documents
2. Record (as-built) Drawings

1.2 QUALITY ASSURANCE

A. One copy of all project closeout submittals shall be forwarded to the Architect/Engineer for review and approval prior to forwarding the information required by this section to the Owner. Approval of these documents shall be considered as a pre-requisite for certification of Final Completion.

1.3 CLOSEOUT, WARRANTY & OPERATION AND MAINTENANCE DOCUMENTS

A. At the Final Completion of the project the General Contractor shall prepare one 3 ring binder titled with the name of the project and date. The binder shall contain, in order, the following:

1. The General Contractor’s name, address, telephone number, fax number and the name of the project manager or contact person representing the General Contractor, including addresses and telephone numbers where that person can be reached for emergency service at all times including nights, weekends, and holidays.

2. The names, addresses, telephone numbers for each major subcontractors including:
   a. Plumbing sub-contractor
   b. Mechanical sub-contractor
   c. Electrical sub-contractor
   d. Roofing sub-contractor

3. When applicable evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:
   a. Certificates of Inspection for Plumbing, Mechanical and Electrical.
   b. Certificates of Occupancy.

4. Certificates of Insurance for products and completed operations.

5. Evidence of payment and release of liens.

7. In order of division, following the order of the sections of this specification, all warranty information specifically required by the sections of this specification.

8. In order of division, following the order of the sections of this specification, catalogs, wiring and control diagrams, manufacturer's data, maintenance and operation instructions, parts lists on all devices, fixtures, machines, appliances, mechanical and electrical equipment, etc., for permanent maintenance records.

1.4 RECORD DOCUMENTS

A. Throughout progress of the work, the contractor shall maintain an accurate record of actual construction and changes of the contract documents.

B. The purpose of the Record Documents is to provide factual information regarding all aspects of the work, both concealed and visible, to enable future modification of the work to proceed without lengthy and expensive site measurement, investigation, and examination.

C. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications as to actual products used and each sheet of drawings and other documents where such entry is required to show the change properly.

D. Accuracy of records shall be such that future search for items shown in the Contract Documents may rely reasonably on information obtained from the Project Record Documents.

E. The Record Documents shall be made available to the Architect/Engineer for review upon request, and the Architect's approval of the current status of Project Record Documents may be a prerequisite to the Architect's/Engineer approval of requests for progress payment and request for final payment under the contract.

F. Record Document Handling:
   1. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work.
   2. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

G. Content: Promptly following receipt of the Owner's Notice to Proceed, secure from the Architect at no charge to the contractor one complete set of all documents comprising the contract. Immediately upon receipt of the job set described in Paragraph 2.01(A) above, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET". Maintain at site for Owner one Record Copy of:
   1. Drawings
   2. Specifications
   3. Addenda
   4. Change Orders and other Modifications to Contract
   5. Architect/Engineer Field Orders or written instructions
   6. Approved shop drawings, product data and samples
   7. Field Test Reports
H. Making entries on Drawings:

1. Using an erasable colored pencil, clearly describe the change by note or drawing.
2. Call attention to the entry by a "cloud" drawn around the area or areas affected.
3. In the event of overlapping changes use different colors for the overlapping changes.
4. Legibly mark drawings to record actual construction such as:
   a. Depths of various elements of foundation in relation to finish first floor datum.
   b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the structure.
   d. Field changes of dimension and detail.
   e. Changes made by Field Order or by Change Order.
   f. Details not on original contract drawings.

I. Make entries in the specifications, addenda and other pertinent documents by legibly marking each section to record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed. Indicate changes made by Field Order or by Change Order.

J. Show on the job set of Record Drawings, by dimension accurate to within one inch, the centerline, etc., of each run of items such as are described above. Clearly identify the item by accurate note such as "cast iron drain", "galv. water", and the like. Show, by symbol or note, the vertical location of the item ("under slab", "in ceiling plenum", "exposed", and the like).

K. At Contract closeout, deliver Record Documents to Architect/Engineer for Owner. Accompany this submittal with a transmittal letter in duplicate containing:

1. Date
2. Project title and number
3. Contractor's name and address
4. Title and number of each Record Document
5. Signature of contractor or his authorized representative

END OF SECTION 017800
SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Throughout progress of the Work of this Contract, maintain an accurate record of all changes in the Contract Documents, as described in Article 3.01 below.

B. Upon completion of the Work of this Contract, transfer the recorded changes to a set of Record Documents, as described in Article 3.02 below.

1.2 RELATED WORK DESCRIBED ELSEWHERE

A. Submittals: Section 01 33 00

1.3 QUALITY ASSURANCE

A. General: Delegate the responsibility for maintenance of Record Documents to one person on the Contractor’s staff as approved in advance by the Owner.

B. Accuracy of records: Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the contract Documents may reasonably rely on information obtained from the approved Record Documents.

C. Timing of entries: Make all entries within 24 hours after receipt of information.

1.4 SUBMITTALS

A. The Owner’s approval of the current status of Record Documents will be a prerequisite to the approval of requests for progress payment and request for final inspection and final payment under the Contract.

1.5 PRODUCT HANDLING

A. Use all means necessary to maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of the recorded data to the final Record Documents. In the event of loss of recorded data, use all means necessary to secure data to the Owner’s approval; such means include, if necessary in the opinion of the Owner, removal and replacement of concealing materials and, in such case, all replacements shall be to the standards originally specified in the Contract Documents at no cost to the Owner.
PART 2 - PRODUCTS

2.1 RECORD DOCUMENTS

A. Job Set: Promptly following award of contract, secure from the Owner, at no charge to the contractor, one complete set of all Documents comprising the Contract.

B. Final Record Documents: At a time near the completion of the Work, but prior to final inspection and final payment, secure from the Owner at no charge to the Contractor, one complete set of all Drawings included in the Contract.

PART 3 - EXECUTION

3.1 MAINTENANCE OF JOB SET

A. Identification: Immediately upon receipt of the job set described in Paragraph 2.01 above, identify each of the Documents with the title “RECORD DOCUMENTS - JOB SET.” Maintain the following on site:
   - Drawings
   - Specifications
   - Addenda
   - Change Orders and other Modifications to Contract
   - Architect/Engineer Field Orders or written instructions
   - Field Test Reports

B. Preservation:
   1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Owner.
   2. Do not use the job set for any purpose except entry of new data and for review by the Owner, until start of transfer of data to final Record Documents.
   3. Maintain the job set at the site of Work as the Architect designates that site.

C. Making entries on Drawings:
   1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by note and by graphic line, as required. Date all entries. Call attention to the entry by a “cloud” around the area or areas affected. In the event of overlapping changes, different colors may be used for each of the changes.

D. Making entries on other Documents:
   1. Where directives issued by the Owner cause changes, clearly indicate the change by note in ink, colored pencil, or rubber stamp.
   2. When changes are caused by Contractor originated proposals approved by the Owner, including inadvertent errors by the Contractor which have been accepted by the Owner, clearly indicate the change by note in erasable colored pencil.
3. Make entries in the specifications, addenda and other pertinent documents by legibly marking each section to record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed. Indicate changes made by Field Order or by Change Order.

4. Make entries in the pertinent Documents as approved by the Owner.

E. Conversion of schematic layouts:

1. In most cases on the Drawings, arrangements of conduits and circuits, piping, duct, and other similar items, is shown schematically and is not intended to portray precise physical layout. The contractor, subject to the Owner’s approval determines final physical arrangement. However, design of future modifications of the facility may require accurate information as to the final physical arrangement of items that are shown only schematically on the Drawings.

2. Shown on the job set of Record Drawings, by dimension accurate to within 24 mm (1”), the center line of each run of items such as conduits and circuits, piping, duct, and other similar items. Clearly identify each item by accurate note. Show, by symbol or note, the vertical location of the item to indicate if it is under slab, in ceiling, exposed, etc. Make all identification sufficiently descriptive that it may be related reliably to the Specifications.

3. The Owner may waive the requirements for conversion of schematic data where, in the Owner’s judgment such conversion serves no beneficial purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Owner.

4. Timing of entries: Be alert to changes in the Work from how it is shown in the Contract Documents. Promptly, and in no case later than 24 hours after the change has occurred and been made known to the Contractor, make the entry or entries required.

F. Accuracy of entries: Use all means necessary, including the proper tools for measurement, to determine actual locations of the installed items.

3.2 FINAL RECORD DOCUMENTS

A. General: The purpose of the final Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of design to proceed without lengthy and expensive site measurement, investigation, and examination. Provide a single bookmarked PDF file with bookmarks for each section and part. Provide 6 CD’s and 2 complete drawing sets of record drawings.

B. Approval of recorded data prior to transfer: Following receipt of the Final Record Documents described in Paragraph 2.01.B above, and prior to start of transfer of recorded data thereto, secure a review by the Engineer and Owner of all recorded data. Make all required revisions.

C. Approval of recorded data prior to transfer: Carefully transfer all change data shown on the job set of Record Drawings to the Final Record Document. Coordinate the changes as required and clearly indicate at each affected detail and other drawing the actual location of items. Call attention to each entry by drawing a “cloud” around the area or areas affected. Make all change entries on the drawings neatly, consistently, and in ink or crisp black pencil.
D. Transfer of data to other Documents: If the Documents (other than Drawings) have been kept clean successfully during progress of the Work, and if entries have been sufficiently orderly thereon to the approval of the Engineer, the job set of those Documents (other than Drawings) will be accepted by the Owner as final Record Documents for those Documents. If any such document is not approved by the Engineer, secure a new copy of that Document from the Owner and carefully transfer the change data to the new copy.

E. Review and approval: Submit the completed total set of Record Documents to the Owner. Participate in review meeting(s) as required by Engineer or Owner. Make all required changes in the Record Documents and promptly deliver the final Record Documents to the Engineer prior to requesting a final inspection and final payment under the contract.

3.3 CHANGES SUBSEQUENT TO ACCEPTANCE

A. The Contractor shall have no responsibility for recording changes in the Work subsequent to acceptance of the Work by the Owner, except for changes resulting from replacements, repairs, and alterations made by the Contractor as part of this guarantee.

END OF SECTION 017839
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Suspended slabs.
2. Slab on Deck
3. Concrete toppings.

B. Products installed, but not furnished, under this Section include the following:

1. Anchor rods and embed plates indicated to be cast into cast-in-place concrete, furnished under Division 05 Section "Structural Steel Framing"

C. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 PERFORMANCE REQUIREMENTS

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 SUBMITTALS

A. Contractor’s Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

B. Product Data:

1. Bar supports
2. Vapor retarders
3. Epoxy Bonding Adhesive
4. Cartridge Injection Adhesive
5. Form materials
6. Form-release agents
7. Evaporation retarder
8. Curing compound
9. Curing and sealing compound
10. Semirigid joint filler
11. Joint-filler strips
12. Controlled low-strength material, including design mixture.

C. Design Mixtures: For each concrete mixture.

1. Mix design submittals shall include test results and/or trial batch data that meet or exceed the required average compressive strength as required by ACI 301.
2. Trial batches shall consist of identical cementitious materials, fine and coarse aggregates, and admixtures to be used for mix design.
3. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Steel Reinforcement Shop Drawings:

1. Drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and bar supports for concrete reinforcement.
3. Identify all step footing locations and associated reinforcing
4. Identify and dimension all grade beam and tie beam construction joints
5. Include slab on grade construction joint reinforcement
6. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   a. Location of construction joints is subject to approval of the Architect.

E. Mill Test Reports (to be provided to the special inspector with each delivery to the site):

1. Submit mill test reports for ASTM A615 reinforcing steel indicating compliance with the ASTM and additional restrictions
2. Submit mill test reports for ASTM A706 reinforcing steel indicating compliance with the ASTM.

F. Qualification Data:

1. For ready-mix concrete manufacturer.
2. For Cartridge injection adhesive installer. Include manufacturer's training certificates or letter from manufacturer certifying training was complete with a list of individuals that were trained

G. Material Certificates: For each of the following indicating compliance with the required standards and signed by manufacturers:

1. Vapor retarders
H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Capillary Barriers

I. Research/Evaluation Reports:

1. Submit ICC reports for the following:
   a. Cartridge Injection Adhesive

J. Hot Weather Program (As required, see below):

1. Describe in detail procedure for working in Hot Weather when concrete temperatures exceed the specified limits. Included detailed description of methods, materials, and equipment to be used to comply with requirements.

K. Substitutions for Cartridge Injection Adhesive:

1. Substitution requests may only be made using products with ICC-ESR reports for the product in the specific substrate.
2. Substitution request shall include signed and sealed calculations demonstrating that the product is capable of providing equivalent performance of the specified product for each specific location and condition when calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code.
3. Substitution request shall specify the diameter and embedment depth of the substituted product
4. Any increase in material cost resulting from the substitution shall be the responsibility of the contractor.

L. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

C. Installer Qualifications: The installer shall be experienced placing, finishing, curing, treating and protecting concrete equal in material, design and scope to that required for this project

D. Cartridge Injection Adhesive Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of anchors shall attend the training session. Training shall consist of a review of the complete process for the installation of the anchors and the use of proper equipment for drilling and installing the anchors, to include but not limited to:
1. Hole drilling procedure. Clarify acceptability of rotary hammer drilling and/or core drilling.
2. Hole drilling equipment
3. Type and diameter of drill bits
4. Hole preparation and hole cleaning technique
5. Hole cleaning equipment
6. Adhesive injection technique
7. Adhesive injection equipment
8. Adhesive curing requirements

E. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

F. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

G. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

H. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

I. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

J. Preinstallation Conference: Conduct conference at Project site.
1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, capillary barrier requirements, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, cartridge injection adhesive installer requirements, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
CAST-IN-PLACE CONCRETE

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement:
   1. Deliver, store, and handle steel reinforcement to prevent bending and damage.
   2. Maintain reinforcement free of dirt and other deleterious materials.
   3. Store reinforcing on dunnage or other supports up off of ground.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.


E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars:
   1. ASTM A706, Grade 60, deformed
   2. ASTM A 615/A 615M, Grade 60, deformed.
      a. With mill tested yield strength not exceeding specified yield by more than 18,000 psi.
      b. With mill tested ultimate strength to mill tested yield strength not less than 1.25
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B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Concrete Brick, Standees, Bolsters, chairs, spacers, supplementary reinforcing steel and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place including measures for supporting and anchoring reinforcing intermediate and top layers of reinforcing. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. Concrete brick supports are limited to use in supporting the bottom mat of below grade foundation reinforcing steel. Concrete brick supports shall consist of solid units of unit strength equal to or greater than associated foundation concrete. Submit material test reports for approval.

C. Cartridge Injection Adhesive: A two part adhesive injection system for anchorage of new reinforcing steel to existing concrete construction.

1. Where adhesive manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following or approved equal:
2. Where specifically indicated in the contract documents provide the following:

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type I/II or Type III unless noted otherwise. Supplement with Fly Ash: ASTM C 618, Class F.
   a. Do not use Type III Portland Cement for Mass Concrete placement.
B. Normal-Weight aggregates: ASTM C 33, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

   1. Coarse Aggregate
      b. Class: Per ASTM C33 requirements for the concrete use and region of the project

   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Accelerating Admixture: Non-Chloride, ASTM C494/494M, Type C.
   4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.
D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: Provide one of the following.
   1. Flexible lightweight, non-staining, polyethylene, closed cell, non-absorbent, uv stable, compressible foam with a pre-scored removable strip to allow for clean and uniform sealant joint as follows:
      a. Density: ASTM D1751
      b. Compression: ASTM D3575
         1) 10% Deflection: 10 psi maximum
         2) 80% Deflection: 126 psi maximum
      c. Water absorption: ASTM D3575, 0.5% volume maximum
   2. Resilient, flexible, non-extruding, asphalt-saturated cellulosic fiber with preformed cap to allow for clean and uniform sealant joint
      a. Density: ASTM D 1751

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Type V, for bonding freshly mixed concrete to hardened concrete.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Compressive Strengths: Compressive strengths specified are as required for structural design. Compressive strength provided shall be increased as required by ACI 318 for exposure class or as required for specialty treatments or finishing of concrete (i.e. polishing)
C. Exposure Class: Unless noted otherwise in drawings or specifications concrete shall be considered exposure class F0, S0, W0 and C0.

D. Admixtures: Use admixtures as noted in mix design and according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use accelerating admixture in concrete as required for cold weather conditions.
   5. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Where colored concrete is indicated add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Suspended Slabs: Proportion normal-weight concrete mixture as follows: (Pump Pads)
   1. Minimum Compressive Strength:
      a. Typical Slabs: 3000 psi at 28 days.
      b. Polished Finished Slabs: Minimum 3500 psi at 28 days, but not less than typical slab strength
   2. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
   3. Air Content:
      a. Coordinate target air content with exposure requirements
      b. Maximum air content for slabs to receive trowel finish shall be 3 percent at point of delivery
   4. Cementitious Materials:
      a. Minimum Cementitious Materials Content: Per ACI 301 requirements based on max aggregate size
      b. For slabs to receive a polished finish fly ash shall not be permitted
   5. Exposure Classes:
      a. Freeze/Thaw Exposure: F2
      b. Sulfate Exposure: S2
      c. Water Contact Exposure: W1
      d. Corrosion Exposure: C2
6. Exposure Classes:

B. Slab on Deck: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength:
   a. Typical Slabs: 3000 psi at 28 days.
   b. Polished Finished Slabs: Minimum 3500 psi at 28 days, but not less than typical slab strength

2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft. plus or minus 3 lb/cu. ft. as determined by ASTM C 567.

3. Air Content:
   a. Coordinate target air content with exposure requirements
   b. Maximum air content for slabs to receive trowel finish shall be 3 percent at point of delivery

4. Cementitious Materials:
   a. Minimum Cementitious Materials Content: Per ACI 301 requirements based on max aggregate size
   b. For slabs to receive a polished finish fly ash shall not be permitted

5. Exposure Classes:
   a. Freeze/Thaw Exposure: F2
   b. Sulfate Exposure: S2
   c. Water Contact Exposure: W1
   d. Corrosion Exposure: C2

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. Unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305 has been submitted and approved comply with the following:
   a. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes.
   b. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Smooth-formed finished surfaces: Class A, 1/8 inch
   2. Rough-formed finished surfaces: Class D, 1 inch

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC’s "Code of Standard Practice for Steel Buildings and Bridges."
2. Anchor rods and embeds shall be securely fastened in formwork prior to placing concrete, and concrete vibrated around the anchor or embed to ensure proper flow of concrete around anchors and embeds.
3. Anchor rod sleeves (where required) shall be accurately located and fastened in formwork prior to placing concrete.
4. Wet setting of anchor rods and embeds is not permitted.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
3.5 **STEEL REINFORCEMENT**

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Anchorage of reinforcement into hardened concrete using cartridge injection adhesive anchors shall only be used where specifically indicated on plans or with written direction from the Engineer of Record for a specific location.

D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   
   1. Foundation reinforcing steel may be supported on solid concrete brick units of strength equal to or greater than foundation concrete.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Welded Wire Reinforcement:

   1. Install welded wire reinforcement in longest practicable lengths
   2. Locate welded wire reinforcement in top 1/3 of slab on grades unless noted otherwise
   3. Locate welded wire reinforcement at mid-depth of concrete slab thickness over deck flutes unless noted otherwise.
   4. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2", but not less than 6". Lace overlaps with wire.
   5. Slabs on Grade 4” or less in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
      
      a. Alternately, welded wire reinforcement may be placed on grade and “hooked”/pulled to the proper location
      b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.

   6. Slabs on Grade greater than 4” in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
      
      a. Placement of welded wire reinforcement on grade or deck and “hooked”/pulled up into slab as concrete is placed is not permitted.
      b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.
7. Elevated slabs: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
   a. Alternately, welded wire reinforcement may be placed on grade and “hooked”/pulled to the proper location
   b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.

3.6 CARTRIDGE INJECTION ADHESIVE

A. Where manufacturer recommends the use of special tools for installation of anchors, such tools shall be used.

B. All facets of hole drilling, hole cleaning, anchor installation, anchor torqueing shall be in strict accordance with the ICC-ESR report and manufacturer’s data.

C. Drill holes perpendicular to substrate surface.

D. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits as indicated in the ICC-ESR report.

E. Drill bits and core bits shall be of diameters indicated in the ICC-ESR report.

F. All holes shall be cleaned with compressed air to remove all drilling dust and other deleterious substances.

G. Remove water from holes to attain a surface dry condition unless specifically permitted otherwise by ICC-ESR report.

H. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete has achieved full design strength.

I. Hilti HIT-HY200 system adhesive shall be installed using the Hilti Safe Set Technology.
   1. The Hilti hollow drill bit and Hilt vacuum system shall be employed.

J. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

K. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

L. Follow manufacturer recommendations to ensure proper mixing of adhesive components.

M. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.
N. Remove excess adhesive from the surface.
O. Shim reinforcement with suitable device to center the reinforcement in the hole.
P. Do not disturb or load reinforcement before manufacturer specified cure time has elapsed.
Q. Observe manufacturer recommendations with respect to installation temperatures.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Provide supplemental reinforcing and/or smooth dowels where indicated at joints.
4. Strip bulkheads from footings, beams, grade beams, tie beams, and slabs and roughen surface of concrete to a minimum 1/4" amplitude while concrete is still plastic.
5. Form keyed joints unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete unless noted otherwise.
6. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
7. Locate joints in slabs on steel deck as follows:
   a. Joints parallel to joists (perpendicular to girders) shall be located at the midpoint between two adjacent joists.
   b. Joints parallel to girders (perpendicular to joists) shall be located at the midpoint of two adjacent girders.
   c. Stagger and offset joints as required to meet the requirements.
8. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
9. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
10. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete.
a. Cut joints as soon as cutting action will not tear, abrade, or otherwise damage surface, but not more than 12 hours after finished, and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and as follows.

1. Do not add water to concrete unless the batched water is specifically noted as less than the mix design and is indicated as such on the batch ticket.
2. Do not add more water than the amount of withheld water which is specifically identified on the batch ticket.
3. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Concrete placed over metal deck shall be placed and screeded level and flat to the specified tolerances, maintaining at least the minimum specified slab thickness as shown on drawings. The contractor shall increase slab thickness as required to compensate for metal deck deflection, residual beam camber and beam deflection in order to achieve a level and flat floor within the specified tolerance.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305.1 has been submitted and approved. At no time shall concrete temperature exceed 95 deg F at time of placement.
2. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and
defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete coordinate with Architectural drawings and specifications.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish, trowel and fine broom finish, or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

2. Apply to mud slabs.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, epoxy terrazzo, polished or another thin-film-finish coating system.

2. Any special “flatness or levelness requirements FF35, FL25

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method without cleavage membrane. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Foundations:
   1. Protect top sides of footings to receive masonry or concrete construction from dirt and debris.
   2. Excavations:
      a. Do not allow excavations directly adjacent to or beneath footings to the absolute greatest extent possible.
      b. Where excavations must occur beneath in place footings or slabs the area shall be careful excavated as to not damage structural elements. The area shall be backfilled and compacted at the end of the work day.
      c. Areas excavated below footings shall be backfilled with Controlled Low-Strength Material.
      d. Areas excavated adjacent to and at or below footing elevation shall be backfilled with Controlled Low-Strength Material unless the area is large enough to be backfilled with control fill in lifts attaining proper compaction between lifts.

F. Slabs:
   1. Protect slabs to remain expose, stained or receive other non-opaque floor coverings or treatments with impervious covers to prevent staining of the slab
   2. Do not allow construction equipment or vehicles to drive on slabs.
   3. Excavations:
      a. Do not allow excavations directly adjacent to or beneath slabs on grade to the absolute greatest extent possible.
      b. Where excavations must occur beneath in place footings or slabs the area shall be careful excavated as to not damage structural elements. The area shall be backfilled and compacted at the end of the work day.
      c. Areas excavated below slabs shall be backfilled with Controlled Low-Strength Material. Areas excavated adjacent to and at or below slab elevation shall be backfilled with Controlled Low-Strength Material unless the area is large enough to be backfilled with control fill in lifts attaining proper compaction between lifts.
      d. Repair vapor retarders per manufacturer's requirements

G. Cure concrete according to ACI 308.1, as follows:
   1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments or polished finish.

b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

a. Apply curing and sealing compound to areas of exposed concrete not to receive any floor treatment, staining, painting or floor covering. Coordinate with finish schedule.

3.13 CONCRETE REPAIRS

A. Where deficient concrete is identified on the job all repairs shall be subject to the EOR and AOR approval.

B. The contractor shall be responsible for enlisting a concrete repair specialists with no less than 5 years of documented concrete repair service and having repaired deficient conditions similar to those identified on no less than 5 projects in the previous five years.

C. The contractor and repair specialists shall prepare a narrative of the proposed repair including detailed methods and material, and submit for EOR approval prior to commencing with repairs.

D. Where repair of deficient work is to remain exposed, the deficient work shall be removed and replaced as directed by the EOR.

3.14 JOINT FILLING

A. Fill all joints in exposed concrete slabs

B. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

D. Install semirigid joint filler full depth in saw-cut joints and at least 1 deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 033000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wedge anchors
   2. Cartridge injection adhesive anchors

B. This specification section is only intended for use when specifically required by the drawings or other referencing specifications and structural applications. This section is not intended for use in non-structural applications or where not specifically referenced by the drawings or other specification sections.

C. Related Sections include the following:
   1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 05 Section "Structural Steel Framing" for anchorage of structural steel.
   3. Division 05 Section "Cold Formed Metal Framing" for anchorage of cold form metal framing where specifically detailed in the contract documents.
   4. Division 05 Section "Engineered Cold Formed Metal Framing" for anchorage of performance based cold form metal framing.

1.3 PERFORMANCE REQUIREMENTS

A. Product substitutions must have capacities equal to or greater than values calculated for each specific condition calculated when calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code. See requirements for substitution submittals.

1.4 DEFINITIONS

A. Post Installed Structural Anchors: Anchors supporting and/or anchoring structural elements of the building which are installed into hardened concrete or masonry and that are specified in the contract documents or performance based shop drawing design submittals for structural elements.
B. Wedge Anchors: A torque-controlled anchor, with an integral cone expander and single piece steel expansion clip providing 360-degree contact with the base material while not requiring oversized holes for installation and an impact section to prevent thread damage with required nuts and washers.

C. Cartridge Injection Adhesive Anchors: An anchor system consisting of rod insert, nut, washer and a cartridge type, two-component polymer or hybrid mortar adhesive system dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

1.5 SUBMITTALS

A. Product Data:
   1. Wedge Anchors
   2. Cartridge Injection Adhesive Anchors

B. Research/Evaluation Reports:
   1. Submit ICC reports for the following:
      a. Wedge Anchors
      b. Cartridge Injection Adhesive Anchors

C. Substitutions:
   1. Substitution requests may only be made using products with ICC-ESR reports for the product in the specific substrate.
   2. Substitution request shall include signed and sealed calculations demonstrating that the product is capable of providing equivalent performance of the specified product for each specific location and condition when calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code.
   3. Substitution request shall specify the diameter and embedment depth of the substituted product
   4. Any increase in material cost resulting from the substitution shall be the responsibility of the contractor.

D. Manufacturer's Instruction: Manufacturer's Installation Instructions

E. Qualification Data: Submit installer qualification data as stated in Quality Assurance section. Qualifications shall be submitted in a letter format for each type of anchor to be installed, and shall include the following:

   1. The specific product to be used
   2. Complete description of installation procedure
   3. Personnel to be trained on anchor installation
   4. Date of Manufacturer training
   5. Manufacturer's training certificates or letter from manufacturer certifying training was complete with a list of individuals that were trained.
1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   a. Coordinate meeting with individual preinstallation conferences for the following
   b. Structural Steel Framing
   c. Cold-Formed Metal Framing
   d. Rough Carpentry

B. Installer Qualifications: The installer shall be experienced in installing anchors equal to type, and into the substrate material required for this project

C. Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of anchors shall attend the training session. Training shall consist of a review of the complete process for the installation of the anchors and the use of proper equipment for drilling and installing the anchors, to include but not limited to:
   1. Hole drilling procedure. Clarify acceptability of rotary hammer drilling and/or core drilling.
   2. Hole drilling equipment
   3. Type and diameter of drill bits
   4. Hole preparation and hole cleaning technique
   5. Hole cleaning equipment
   6. Adhesive injection technique
   7. Adhesive injection equipment
   8. Anchor rod, nut and washer material requirements and associated cleaning requirements
   9. Anchor and Anchor rod installation
   10. Anchor tightening
   11. Adhesive curing requirements

D. Certifications: All anchors shall have an ICC ESR Evaluation report indicating conformance with the current applicable Acceptance Criteria for the building code applicable to the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Keep anchors, rod materials, nuts and washers in manufacturer's packaging with label intact until needed for use.

B. Keep anchors free of dirt and debris.

C. Store anchors in a clean dry area

D. Protect anchors from corrosion and deterioration.

E. Store anchors and adhesives in strict accordance with manufacturer's requirements.
2.1 MATERIALS

A. Nuts: Having a proof load stress equal or greater than the minimum tensile strength of the associated anchor where type and strength is not specifically indicated by anchor or adhesive manufacturer.

B. Washers: Of type and material compatible with nuts unless specifically indicated by anchor or adhesive manufacturer.

C. Plate Washers: Provide ASTM A 36 plate washers of size and configuration specifically indicated.

2.2 CORROSION RESISTANCE

A. Anchors and Anchor Bodies

1. Uncoated Carbon Steel: Carbon steel anchors uncoated and free from oil, lubricants and other deleterious substances. Acceptable for use as follows:
   a. Interior dry conditions

2. Zinc Plated: Zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) Acceptable for use as follows:
   a. Interior dry conditions

3. Hot Dip Galvanized: Carbon steel anchors with hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:
   a. Interior dry conditions
   b. Exterior conditions
   c. Anchoring galvanized steel elements

4. Stainless Steel: AISI Type 304 or 316 stainless steel and complying with ASTM F 593. Acceptable for use as follows:
   a. Anchoring treated lumber elements
   b. Anchoring stainless steel elements

B. Nuts

1. Uncoated carbon steel: Acceptable for use as follows:
   a. With Uncoated Anchors

2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:
2. POST INSTALLED STRUCTURAL ANCHORS 050520 - 5

a. With Zinc Plated Anchors
b. With Hot Dip Galvanized Anchors

3. Stainless Steel: ASTM F594. Acceptable for use as follows:
   a. With Stainless Steel Anchors

C. Washers

1. Uncoated carbon steel: Acceptable for use as follows:
   a. With uncoated anchors
2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:
   a. With Hot Dip Galvanized Nuts
3. Stainless Steel: AISI Type 304 or 316 stainless steel. Acceptable for use as follows:
   a. With Stainless Steel Nuts

D. Plate Washers:

1. Uncoated carbon steel: Acceptable for use as follows:
   a. With Uncoated Nuts
2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:
   a. With Hot Dip Galvanized Nuts

2.3 WEDGE ANCHORS

A. Provide anchors with length identification markings conforming to ICC-ES AC01 or ICC-ES AC193.

B. Size: As indicated on drawings

C. Embedment depth: As indicated on the drawings but not less than the manufacturer’s documented minimum embedment depth. Where not specifically indicated use manufacturer’s minimum documented embedment depth.

1. Embedment depth is from surface of concrete or masonry. Anchor lengths and extent of threads shall account for embedment depth, connected elements, plate washers, washers, nut and appropriate stick thru.

D. Concrete Anchors:
1. Anchors shall be tested in accordance with ACI 355.2 and the most recent issue of ICC-ES AC193 including the following:
   a. All mandatory testing
   b. Shear and tension in cracked concrete.
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 318 Appendix D

3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:
   a. Hilti Kwik Bolt TZ with nut and washer, of required finish, ICC ESR-1917
   b. Approved equal (See substitution requirements)

E. Masonry Anchors:

1. Anchors for masonry shall be tested in accordance with most recent edition of ICC-ES AC01 including the following
   a. All mandatory testing
   b. Seismic tension and shear
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 530

3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:
   a. Hilti Kwik Bolt 3 with nut and washer, of required finish, ICC ESR-1385.
   b. Approved equal (See substitution requirements)

2.4 CARTRIDGE INJECTION ADHESIVE ANCHORS

A. Provide anchors with length identification markings conforming to ICC-ES AC58 or ICC-ES AC308.

B. Size: As indicated on drawings

C. Embedment depth: As indicated on the drawings but not less than the manufacturer’s documented minimum embedment depth. Where not specifically indicated use manufacturer’s minimum documented embedment depth.
   1. Embedment depth is from surface of concrete or masonry. Anchor lengths and extent of threads shall account for embedment depth, connected elements, plate washers, washers, nut and appropriate stick thru.

D. Adhesive: Two component system complying with ASTM C-881 Type I and IV, Grade 3, Class A, B and C

E. Concrete Anchors:
1. Anchors shall be tested in accordance with the most recent issue of ICC-ES AC308 including the following:
   a. All mandatory testing
   b. Shear and tension in cracked concrete.
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 318 Appendix D as amended by the specific design provisions of ICC-ES AC308

3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:
   a. HAS-E Standard or HAS SS rods, washers, and nuts of required finish with Hilti HIT RE 500-SD Adhesive Anchorage System for anchorage to concrete, ICC ESR-2322.
   b. Approved equal (See substitution requirements)

F. Masonry Anchors:

1. Anchors for masonry shall be tested in accordance with most recent edition of ICC-ES AC58 including the following
   a. All mandatory testing
   b. Seismic tension and shear
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 530

3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:
   b. Approved equal (See substitution requirements)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. Installation constitutes acceptance of existing conditions and responsibility of satisfactory performance.
3.2 INSTALLATION, GENERAL

A. Where manufacturer recommends the use of special tools for installation of anchors, such tools shall be used.

B. Match mark and drill, match drill or use other methods to ensure anchors are properly located.

C. Do not adjust anchor location after installation. Coordinate with EOR for modifications to connected element where anchors are incorrectly located.

D. Drill holes perpendicular to substrate surface.

E. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits as indicated in the ICC-ESR report.

F. Drill bits and core bits shall be of diameters indicated in the ICC-ESR report.

G. All holes shall be cleaned with compressed air to remove all drilling dust and other deleterious substances.

H. Remove water from holes to attain a surface dry condition unless specifically permitted otherwise by ICC-ESR report.

I. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

J. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

K. Perform anchor installation in strict accordance with manufacturer instructions and ICC-ES report.

L. Anchors shall be installed perpendicular to the substrate face within plus or minus 5 degrees unless specifically permitted otherwise by ICC-ESR report.

M. Install plate washers where specifically indicated or where connected elements have oversized holes.

N. Install a round washer under nuts. Round washers are in addition to plate washers where plate washers are required.

3.3 WEDGE ANCHORS

A. Protect threads from damage during anchor installation.

B. Set anchors to manufacturer’s recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within
POST INSTALLED STRUCTURAL ANCHORS

3.4 CARTRIDGE INJECTION ADHESIVE ANCHORS

A. Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive.

B. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

C. Follow manufacturer recommendations to ensure proper mixing of adhesive components.

D. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.

E. Remove excess adhesive from the surface.

F. Shim anchors with suitable device to center the anchor in the hole.

G. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

H. Observe manufacturer recommendations with respect to installation temperatures.

3.5 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

B. Galvanizing Repairs: Prepare and repair damaged galvanized coatings with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.
SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Bearing Plates

B. Products furnished, but not installed under this Section:

1. Anchor rods and embed plates indicated to be built into masonry, installed under Division 04 Section "Unit Masonry".
2. Anchor rods and embed plates indicated to be cast into cast-in-place concrete, installed under Division 03 Section "Cast-in-place-Concrete"

C. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Post Installed Structural Anchors" for wedge, and adhesive anchors

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges" and as modified herein.

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

1.4 PERFORMANCE REQUIREMENTS
A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering design by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using AISC 360.
2. Use LRFD; data are given at factored-load level.
3. All bolted connections for bracing members shall be designed and fabricated as slip critical connections to allow for field reaming of holes to address fit-up issues.
4. All bolted connections for axial loaded members shall be designed and fabricated as slip critical connection to allow for field reaming of holes to address fit-up issues.
5. The minimum number of bolts for any connection shall be two.
6. All steel to steel connections shall extend at least two thirds of the depth of the supported member being connected.

B. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360

1.5 SUBMITTALS

A. Product Data:

1. Non-shrink grout.
2. Post installed structural anchors: See specification section 050520

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings showing plan location and elevation of all embedded items.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Include scale drawings of all gusset plates.
6. Provide minimum 1/4" thick cap plates at the ends of all exposed HSS members, and at the top of all HSS columns.
7. Equally space filler beams or joists between columns and/or other dimensioned beams unless noted otherwise.
8. Identify members and connections of the seismic-load-resisting system.
9. Indicate locations and dimensions of protected zones.
10. Identify demand critical welds.

C. Delegated-Design Submittal:

1. For structural steel connections indicated to comply with design loads provide structural design data signed and sealed by the qualified professional engineer responsible for their preparation.
a. Each individual calculation shall be clearly labeled in coordination with erection drawings such that it identifies the member(s) that the connection applies to.

2. Professional Engineer's Statement: A written statement indicating that the for fabrication shop drawings incorporate all the connection requirements included in the calculations submitted for approval inclusive of any corrections required in response to shop drawing review comments. The statement shall be prepared by, and signed and sealed by the professional engineer that completed the calculations submittal.

D. Slip Critical Bolt Installation Statement: A written statement indicating the means and equipment to be used to achieve the tightening requirements for clip critical bolt installation. Statement shall identify the specific pre-installation required by the special inspections and acknowledge that this testing must be coordinated and completed prior to commencement of erection.

E. As-built anchor rod and embed survey

F. Welding certificates

1. Submit welding certificates for all individuals expected to be performing field welding

G. Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each field welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

H. Qualification Data:

1. Fabricator
2. Erector
3. Post Installed Structural Anchor Installer

I. Research/Evaluation Reports:

1. Post Installed Structural Anchors: See specification section 050520

J. Product Test Reports: For the following:

K. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
C. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category SBD (Conventional Steel Building Structures)

D. Fabricator Responsibility

1. The structural steel fabricator shall be responsible for enlisting the Steel Joist fabricator as a direct subcontractor.
2. The structural steel fabricator shall be responsible for enlisting the Cold Formed Steel Purlin fabricator as a direct subcontractor.
3. The structural steel fabricator shall be responsible for enlisting the steel erector as a direct subcontractor.

E. Structural Steel and Architectural Structural Steel Installer Qualifications: The erector shall be experienced in installing structural steel equal in material, design and scope to the structural steel required for this project.

F. Post Installed Structural Anchor Installer: See specification section 050520 for requirements

G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

H. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

I. Preinstallation Conference: Conduct conference at Project site.

1. Review special inspection and testing and inspecting agency procedures for field quality control.
2. Review items requiring special inspection and testing that must be tested and inspected prior to installation of decking, concrete slabs, or other items that might limit access to the item to be tested or inspected
3. Review welding requirements
4. Review electrode storage requirements
5. Review pre-construction bolt installation verification
6. Review bolt installation calibration requirements

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes and Tees: ASTM A 992.

B. Channels, Angles-Shapes:

1. ASTM A 36 unless noted otherwise
2. ASTM A 572/A 572M, Grade 50 where indicated.

C. Plate and Bar:

1. ASTM A 36 unless noted otherwise
2. ASTM A 572/A 572M, Grade 50 where indicated.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

1. Square or Rectangular HSS: Fy=46 KSI
2. Round HSS: Fy=42 KSI

E. Welding Electrodes: Comply with AWS requirements.

1. All weld filler metal shall meet the requirements of H16 as tested in accordance with AWS A4.3 per AISC 341-05 Appendix W.
2. All weld filler metal shall have a minimum CVN toughness of 20 ft-lbs at 0 degrees Fahrenheit.
3. Demand Critical Welds: All weld filler metal shall have a minimum CVN toughness of 20 ft-lbs at minus 10 degrees Fahrenheit per AWS and 40 ft-lbs at 70 degrees Fahrenheit per AISC 341-05 Appendix X.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish:
   a. Plain for primed or painted steel

2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
   a. Finish:
      1) Plain for unprimed steel or steel receiving standard shop primer.
      2) Mechanically deposited zinc coating, ASTM B 695, Class 50 for hot galvanized steel or steel to receive high performance top coating.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish:
   a. Plain for primed or painted steel

2. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type.
   a. Finish:
      1) Plain for unprimed steel or steel receiving standard shop primer.
      2) Mechanically deposited zinc coating, ASTM B 695, Class 50 for hot galvanized steel or steel to receive high performance top coating.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex or round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish:
   1) Plain for unprimed steel or steel receiving standard shop primer.
   2) Mechanically deposited zinc coating, ASTM B 695, Class 50 for hot galvanized steel or steel to receive high performance top coating.

D. Post Installed Structural Anchors: See specification section 055020 for products
2.3  PAINT

A. Column Base Paint: SSPC-Paint 33, “Coal Tar Mastic, Cold Applied”.
   1. Typical at column bases below finished floor or below grade.

B. Galvanizing Repair Paint: ASTM A 780.

2.4  NONSHRINK GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5  FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC’s "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6  SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
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1. Joint Type:
   a. Snug tightened unless noted otherwise
   b. Slip critical as indicated and for all members of the SLRS.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
2. Remove backing bars and runoff tabs, back gouge, and grind steel smooth.

2.7 CLEANING

1. Clean and prepare steel surfaces that are to remain unprimed according to SSPC-SP 2, "Hand Tool Cleaning."
2. Clean and prepare steel surfaces that are to receive standard primer according to SSPC-SP 3, "Power Tool Cleaning."
3. Clean and prepare steel surfaces that are to receive special primer according to the associated painting specification. When not specifically noted the minimum cleaning shall be SSPC-SP 6, "Commercial Blast Cleaning."

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize loose and hung lintels, shelf angles, all exposed exterior steel and all steel located in exterior masonry walls unless noted otherwise. Coordinate with drawings and specifications.
   a. Galvanized elements to be top coated shall not be quenched, and shall be swept blast to ensure proper adhesion of top coats.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections

B. All source quality control shall be completed by the fabricator’s personnel unless noted otherwise and shall be in accordance with the certified fabricator’s quality control manual, AISC Code of Standard Practice, and AWS D1.1.

C. Testing Agency: Fabricator will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports as required.
D. Complete Joint Penetration (CJP) Welds: In addition to visual inspection, 100% of all shop completed full penetration welds shall be ultrasonically tested in accordance with ASTM E164 and all defects repaired as required by AWS D1.1.

E. Special inspections are not required at the source of fabrication based on the requirement for an AISC certified fabricator.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

G. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

H. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M.

I. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified as-built survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

1. Where ungrouted anchor rod sleeves are required caulk the annular surface between the sleeve and the anchor rod to prevent grout from entering the sleeves.
2. Set plates for structural members on wedges, shims, or setting nuts as required.
3. Weld plate washers to top of baseplate as indicated.
4. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
5. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
   a. Use grout forms and grout surcharging as required to ensure that grout completely fills the space below bearing or base plate, and no voids remain.
6. Paint base plates, anchor bolts and sections of columns below grade and below finished floor with Coal Tar Mastic Paint.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
   1. For slip critical connections enlarge hole to next standard hole size and provide next standard bolt size.

I. Pour stops and edge angles: Pour stops and edge angles shall be field installed based on global building control lines to ensure overall building geometry is maintained.
   1. Do not located based on local member geometry.

3.4 FIELD CONNECTIONS
A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As indicated on shop drawings.

B. Finger Tight Bolts: All joints noted as finger tight shall be hand tightened as required to install elements. Do not tighten by mechanical means

1. Provide jam nuts to prevent nut from backing off.
2. After initial tightening turn nut and jam nut in opposite direction to bind them against one another.

C. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars and/or runoff tabs at all exposed locations and at all members and connections of the SLRS, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

D. Post Installed Structural Anchors: See specification section 055020 for products

3.5 FIELD PAINTING

A. Column bases: Paint column bases below grade and/or below finished floor with coal tar mastic paint.

B. Field painting of structural steel for finished appearance in exposed conditions or for high performance coating systems is specified in Division 09 painting sections.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
B. Touchup Painting: At all exterior and exposed interior conditions promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a primer of same type as shop primer used on adjacent surfaces. Coordinate with Part 2 priming requirements

END OF SECTION 051200
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Composite floor deck.

B. Products furnished, but not installed under this section:
   1. Sound-Absorbing Insulation for non-cellular acoustical roof deck. Installed under Division 07 Section "Insert title of applicable roofing Section"
   2. Sound-Absorbing Insulation for acoustical dovetail roof deck. Installed under Division 07 Section "Insert title of applicable roofing Section"

C. Related Sections include the following:
   1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
   3. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
   4. Division 05 Section "Structural Steel Framing" for framing deck openings with miscellaneous steel shapes.
   5. Division 09 painting Sections for field painting of primed and galvanized deck.

1.3 PERFORMANCE REQUIREMENTS:

A. Deck Fastening Systems: The basis of design for the deck fastening systems is outlined in this specification and the contract documents. Product substitutions must result in diaphragm shear strength, and uplift resistance capacities equal or greater than values calculated for each specific condition. The baseline strength shall be calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code. See requirements for substitution submittals.
1.4 DEFINITIONS

1.5 SUBMITTALS

A. Product Data:

1. Electrodes
2. Galvanizing Repair Paint
3. Sidelap fasteners
4. Mechanical fasteners
5. Powder Actuated Fasteners

B. Contractor’s Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

C. Quality Control Plan: Job specific Quality Control Plan for the Steel Deck Erector

D. Shop Drawings: Submit detailed layout showing placement extent of each type of deck including the following:

1. Coordinate layout with approved Engineered cold-formed metal trusses and Steel joist shop drawings
2. Anchorage pattern for each type of deck and each anchorage condition
3. Details for flat sump pans and associated anchorage
4. Details of hip, ridge and valley plates and associated anchorage
5. Details of cover plates and associated anchorage and changes in deck direction.
6. Details of end jointed conditions
7. Details of side lap conditions.
8. Details of girder fills
9. Details of finish/filler strips
10. Details of pour stops

E. Product Certificates: For each type of steel deck, signed by product manufacturer.

F. Welding certificates.

1. Submit welding certificates for all individuals expected to be performing field welding

G. Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code -Steel" and AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.
3. Supplement standard WPS with parameter for time per weld for each size of weld.

H. Research/Evaluation Reports:
1. For steel decking in fire resistance assemblies submit reports per the assembly specification.
2. Submit ICC reports for the following:
   a. Side lap Fasteners
   b. Mechanical fasteners
   c. Power actuated fasteners

I. Qualification Data: Submit Powder Actuated Fastener installer qualification data as stated in Quality Assurance section. Qualifications shall be submitted in a letter format for each type of anchor to be installed, and shall include the following:
   1. The specific product to be used
   2. Complete description of installation procedure
   3. Personnel to be trained on fastener installation
   4. Date of Manufacturer training
   5. Manufacturer’s training certificates or letter from manufacturer certifying training was complete with a list of individuals that were trained.

J. Substitution for Deck Fastening Systems:
   1. Substitutions to a welded fastening system in lieu of powder actuated fastening system will not be permitted except as specifically noted.
   2. Substitution requests may only be made using products with ICC-ESR reports for the product indicating approval for use of the product in the specific condition existing on this project.
   3. Substitution requests shall be include signed and sealed calculations demonstrating that the product is capable of providing equivalent performance of the basis of design product for each specific location and condition when calculated using the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code.
   4. An increase in material or labor cost resulting from the substitution shall be the responsibility of the contractor.

1.6 QUALITY ASSURANCE

A. Quality Control Plan: Each deck erector shall provide a job specific Quality Control Plan.
   1. The plan shall specifically identify all QC and QA inspections erector will be completing, the frequency of those inspections and the erector’s personnel and/or erector’s testing agency that will be completing the specific inspections.
   2. The plan shall comply with the latest edition of the SDI “Standard for Quality Control and Quality Assurance for Installation of Steel Deck”.

B. Manufacturer Qualifications: A manufacturer certified by SDI to manufacture steel deck complying with applicable standard specifications and load tables of SDI "Specifications".
   1. The Manufacturer for steel deck bearing on structural steel or steel joists shall be act as a direct subcontractor of the structural steel fabricator.
2. Manufacturer's responsibilities include providing professional engineering services for designing deck to comply with performance requirements.

C. Erector Qualifications: The erector shall be experienced in installing steel deck equal in material, design and scope to the steel deck required for this project.

1. The steel deck erector for steel deck bearing on structural steel or steel joists shall act as a direct subcontractor of the structural steel fabricator.

D. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel" and AWS D1.3, "Structural Welding Code - Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

G. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

H. SDI Specifications:


I. Professional Engineering Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated.

J. Powder Actuated Fastener Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of fasteners shall attend the training session. Training shall consist of a review of the complete process for the installation of the fasteners and the use of proper equipment for the installation.

K. Preinstallation Conference: Conduct conference at Project site in conjunction with preinstallation conference for the supporting substrate (i.e. structural steel, steel joists, etc.)

1. Review special inspection and testing and inspecting agency procedures for field quality control.
2. Review items requiring special inspection and testing that must be tested and inspected prior to installation of decking
3. Review welding requirements
4. Review electrode storage requirements

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

C. Store steel decking on supports off the ground

D. Keep steel decking free of dirt and foreign matter.

PART 2 - PRODUCTS

2.1 COMPOSITE FLOOR DECK

1. Type "CFD8"

   a. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), G60 zinc coating.
   b. Profile Depth: 3 inches
   c. Properties as follows:

      1) Design Uncoated-Steel Thicknesses: 0.0474 inch
      2) Area (As): 0.810 in²/ft
      3) Moment of Inertia (I): 0.1311 in⁴/ft
      4) Section Modulus (Sp): 0.799 in³/ft
      5) Section Modulus (Sn): 0.826 in³/ft
      6) Yield Strength (Fy): 40 ksi

   d. Span Condition: Double span unless noted otherwise.
   e. Side Laps: Interlocking

   f. End Joints: Butted
2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Powder Actuated Fasteners: Basis of design product as indicated on drawings. See requirements for substitution submittals. Where not specifically indicate the basis of design fasteners shall be Hilti fasteners in accordance with ICC ESR-2197.

C. Mechanical Fasteners: Unless noted otherwise, ASTM C1513, corrosion-resistant coated, self-drilling, self-tapping steel drill screws. No. 10 minimum diameter unless noted otherwise.

D. Side-Lap Fasteners: Unless noted otherwise, ASTM C1513, corrosion-resistant coated, self-drilling, self-tapping steel drill screws. No. 10 minimum diameter unless noted otherwise.

E. Welding Electrodes: Comply with AWS standards.

F. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, grade, thickness, and finish to match associated deck. Profile as required for application.

G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated. Where not specifically indicated provide as recommended by SDI Publication No. 30 for overhang and slab depth.

1. Provide a stiffened return lip on the vertical lip of all pour stops.

H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

I. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, coordinate drain assembly opening requirements plus 6” all sides (minimum 24”x24”) of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A 780.

K. Repair Primer: Manufacturer's standard rust-inhibitive primer of same type and color as shop primer.

L. Protection Zone Marking Paint: Easily identifiable canister spray paint.

M. Fastener Type Marking Paint: Easily identifiable canister spray paint

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
3.2 INSTALLATION, GENERAL

A. Do not install powder actuated fasteners or other penetrating type fasteners in protected zones.

B. In cases where varying type powder actuated fasteners are required each beam/ joist support shall be marked with color coded “fastener type marking paint” to identify which fastener type is to be used at specific beam/ joists.

C. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

D. Locate deck bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide flat sump plates at all roof drains

I. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

J. Welding: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

K. Mechanical Fasteners: Locate mechanical fasteners and install according to drawings, and the following requirements:

   1) Minimum edge distance and center to center spacing of fasteners shall be three fastener diameters unless noted otherwise.

   2) Minimum screw penetration shall leave at least 3 exposed threads on the backside of connection unless noted otherwise.

3.3 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members as indicated.

B. Fasten roof deck side laps and perimeter edges as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. Lapped unless noted as butted.

D. Roof Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

E. Miscellaneous Roof-Deck Accessories: Install hip, ridge and valley plates, cover plates, finish/filler strips, end closures, and reinforcing channels according to deck manufacturer's written instructions.

1. Provide cover plates at changes in deck direction unless noted otherwise
2. Provide hip, ridge, and valley plates at all changes in roof planes.
3. Provide reinforcing channels at all deck edges including framed penetrations to ensure the deck edge is properly supported

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members as indicated.

B. Fasten floor deck side laps and perimeter edges as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Butted unless noted as lapped.

D. Pour Stops and Girder Fillers: Fasten steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor-Deck Closures: Fasten steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100
SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel pipe and tube railings.

B. Related Requirements:

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

   4.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency.
B. Welding certificates.
C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING
A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS
A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.
C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

A. General: Provide the following:
   1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
   2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   3. Provide Phillips tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. As detailed.
2. By flush bends or by inserting prefabricated flush-elbow fittings.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

B. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

3.6 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.
3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213
SECTION 055300 - METAL GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal bar gratings.

B. Related Sections:
   1. Division 05 Section "Structural Steel Framing" for structural-steel framing system components.
   2. Division 05 Section "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Walkways and Elevated Platforms Other Than Exits: Uniform load of 150 lbf/sq. ft. (2.87 kN/sq. m).
   2. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Formed-metal plank gratings.
   2. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.
C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   4. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).

D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205).

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide [Type 304] [Type 316] stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.


F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work:

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
   1. Fabricate toe plates for attaching in the field.
   2. Toe plate Height: 4 inches (100 mm) unless otherwise indicated.

2.5 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
5. Fisher & Ludlow; Division of Harris Steel Limited.
7. Grupo Metelmex, S.A. de C.V.
8. IKG Industries; a division of Harsco Corporation.
10. Ohio Gratings, Inc.
11. Seidelhuber Metal Products; Division of Brodhead Steel Products.

B. Welded Steel Grating:

1. Bearing Bar Spacing: 15/16 inch (24 mm) o.c.
2. Bearing Bar Depth: 1 inch (25 mm).
3. Bearing Bar Thickness: As required to comply with structural performance requirements.
4. Crossbar Spacing: 4 inches (102 mm) o.c.
5. Grating Mark: As indicated.
7. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

C. Pressure-Locked Steel Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars.

1. Bearing Bar Spacing: 15/16 inch (24 mm) o.c.
2. Bearing Bar Depth: 1 inch (25 mm).
3. Bearing Bar Thickness: As required to comply with structural performance requirements Insert thickness.
4. Crossbar Spacing: 4 inches (102 mm) o.c.
5. Grating Mark: As indicated.
7. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

D. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced 15/16 inch (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced less than 15/16 inch (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
5. Furnish threaded bolts with nuts and washers for securing grating to supports.
6. Furnish self-drilling fasteners with washers for securing grating to supports.
7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Kee Industrial Products, Inc.; Grating Clip.
      2) Lindapter North America, Inc.; Grate-Fast.

E. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
   1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

F. Do not notch bearing bars at supports to maintain elevation.

2.6 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
   1. Unless otherwise indicated, fabricate from same basic metal as gratings.
   2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1- inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:
   1. Exterior.
   2. Interior, where indicated.

2.7 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.
C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toe plates to gratings by welding at locations indicated.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 INSTALLING EXPANDED-METAL GRATINGS

A. Attach aluminum units to steel supporting members by bolting at 6-inch (150-mm) intervals.

B. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.4 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055300
SECTION NUMBER 133423 - CUSTOM MODULAR MECHANICAL EQUIPMENT ENCLOSURE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work under this Section shall include furnishing all materials, equipment and performing all operations necessary for the complete production, packaging, delivery, factory testing and assembling the modular mechanical equipment room as specified.

B. This section covers the modular mechanical equipment room indicated.

C. This specification covers the design, manufacturing and installation of a prefabricated enclosure. Field fabricated systems shall not be allowed.

D. Work included: Supply all material and labor required to deliver and install the structural enclosure system.

E. Related Sections:
   1. 033000 Cast In Place Concrete
   2. 050520 Post Installed Anchors
   3. 051200 Structural Steel Framing

1.2 WORK NOT INCLUDED

A. Installation of unit, support steel and associated work on site.

1.3 REFERENCES

A. Design and fabrication shall be in accordance with the latest editions of the following codes, ordinances and standards, where applicable.

   1. American Society for Testing and Materials (ASTM)
   2. Occupational Safety and Health Association (OSHA)

B. Drawing References

   1. Mechanical plan and detail drawings.
   2. Structural Plan, detail drawings, notes and specifications.
   3. Electrical plan and detail drawings.
   4. Equipment schedules.

1.4 PERFORMANCE REQUIREMENTS

A. Design Loads: Provide framing capable of withstanding the design loads within the limits and under the conditions indicated.

   1. All load combinations in accordance with the referenced building code.
a. See Structural Design Criteria for loadings also.

2. Wind Loads:
   a. Compute base wind pressures using the structural design criteria given, and IBC 2015 and ASCE 7-10.
   b. Compute internal pressures using the enclosure classification given in the structural design criteria.
   c. All member loads shall be based on components and cladding pressures. Pressures may be calculated based on effective wind area as defined by ASCE 7. The calculated pressure shall be applied to the actual tributary width without reduction.
   d. All anchorage loads shall be based on components and cladding pressures. Pressures shall be calculated with the effective wind area equal to the actual area tributary to the anchorage without reduction.
   e. End wall verticals shall be designed to resist wall components and cladding pressures.
   f. Shear Loads: As required by the manufacturer by design.
   g. Blocking Panel Loads: As required by the manufacturer by design.

3. Seismic Loads:
   a. Compute Seismic Load Factors to calculate seismic forces using structural design criteria given, and IBC 2015 and ASCE 7-10.
   b. Shear Truss Loads: As required by the manufacturer by design.
   c. Blocking Panel Loads: As required by the manufacturer by design

B. Deflection Limits: Design framing system to withstand design loads without deflections greater than the following:

1. Super Structure Roof:
   a. Live Load Vertical deflection of 1/240 of span not to exceed ¾ inch max.
   b. Total Load Vertical deflection of 1/180 of span not to exceed 1 inch max.
   c. End wall Vertical horizontal deflection:
   d. 1/240 when acting as backup for material other than masonry
   e. Total horizontal deflection of ¾ inch with assumed pin roller condition

C. Design framing system to provide for movement of framing members without damage or overstressing, sheathing failure, window/door panel failure, connection failure, undue strain on fasteners and anchors, or

1.5 SUBMITTALS

A. Submit shop drawings including plans, elevations and details, along with product data in accordance with the vendor data requirements form. Include construction details, material descriptions, profiles and finishes of components.

B. Shop drawings of mechanical enclosure shall include cross-sections and details of casing construction, dimensions, details of typical panel joint construction, insulation, components installation, items to be shipped loose for site installation, etc.
C. Detailed manufacturer's descriptive literature, configuration, materials of construction, dimensions, capacities, installation and operating instructions, parts lists, etc. required to demonstrate compliance with specifications shall be submitted for approval prior to fabrication.

D. Submit detailed shop drawings showing all louvers and control dampers, personnel and equipment roll-up access doors, floor drains, lights, convenience outlets, electrical components, pipe connections, utility openings, duct supply/return locations and configurations of components.

E. Provide wiring diagrams and terminal points for control panels provided with units.

F. Provide wiring diagrams and terminal points for power panels provided with units.

G. Submit manufacturer’s color charts showing the full range of colors available for factory finished aluminum.
   1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.

H. Product reports to be furnished by enclosure system manufacturer in accordance with Division 1, Submittals. Submit product reports from a qualified independent testing agency indicating each type of panel system that complies with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable if for current manufacturer and indicative of products used on this project.

I. Submit current documentation indicating regular, independent quality control monitoring under a nationally recognized building code review and listing program.

J. Product Data:
   1. Fasteners
   2. Electrodes
   3. Galvanizing Repair Paint
   4. Hangers and Clips
   5. Post installed structural anchors: See specification section 050520

K. Shop Drawings:
   1. Submit detailed layout indicating placement of framing, panels, and blocking panels, signed and sealed by the professional engineer responsible for the design.
      a. Clearly indicate clear spacing between frames where specifically noted in contract documents.
      b. Frames shall be located as dimensioned on plans, or at the associated designed and detailed pier, column or post support.
   2. Submit individual frame, panel and blocking panel drawings, signed and sealed by the professional engineer responsible for the truss design. Include the following:
a. Detailed description of design criteria of the frame
b. Engineering analysis indicated member stresses and frame deflections
c. Member sizes and thickness
d. Frame joint connections
e. Frame support reactions
f. Frame member reinforcement and associated connection requirements.

3. Submit permanent bracing drawings including layout of bracing and associated connection details, signed and sealed by the professional engineer responsible for the truss design.

4. Submit details, signed and sealed by the professional engineer responsible for the design for the following:
   a. Supplemental framing and associated connections of adequate strength and geometry for proper structural support and flush bearing of sheathing edges. Frame to Frame and panel to panel connections. Indicate specific product to be used.
   b. Blocking panel anchorage to all framing.
   c. Panel to structure anchorage based on the structural elements included in the contract documents. Indicate specific product to be used.
   d. Field applied local member reinforcement
   e. Details for permanent bracing connections.
   f. Indicate limitations for connections to frame or other members made by other trades. Coordinate with General Contractor and all subs for preferred hanging methods for piping, ductwork, and other similar elements.

5. Submit comprehensive design analysis results for each frame, panel, blocking panel, supplemental framing member and all other components designed under this specification. Analysis results shall be signed and sealed by the qualified professional engineer responsible for their preparation. As a minimum, results shall include the following:
   a. Design criteria
   b. Standard and Special Loading. Clearly identify frame loadings separately
   c. Member Stresses
d. Dead, Live, and Total Load deflections
e. Resulting member sizes, thicknesses and strengths
   f. Anchorage forces and design of anchorage to supporting structure. Supporting structure assumptions for anchorage design shall be based strictly on information included in the contract documents.

6. Qualification Data:
   a. Enclosure Manufacturer
   b. Powder Actuated Fastener Installer
c. Post Installed Structural Anchor installer
d. Powder Actuated Fastener Installer: Submit installer qualification data as stated in Quality Assurance section. Qualifications shall be submitted in a letter format for each type of anchor to be installed, and shall include the following:
   e. The specific product to be used
   f. Complete description of installation procedure
L. QUALITY ASSURANCE

1. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

2. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

3. Installer Qualifications:
   a. The installer shall be experienced in installing structures equal in material, design and scope to the structure required for this project.
   b. Installation shall be by the manufacturer or an experienced installer, which has been in the business of installing specified enclosure systems for at least ten years and can show evidence of satisfactory completion of projects of similar size, scope and type.

4. Manufacturer’s Qualifications:
   a. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
   b. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
   c. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 “Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems” as issued by the ICC-ES.

5. Powder Actuated Fastener Installer: All installers shall be experienced in installing anchors equal to type and into the substrate material required for the project. All installers shall have a manufacturer’s training certificate.

6. Post Installed Structural Anchor Installer: See specification section 050520 for requirements

7. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   a. Review special inspection and testing and inspecting agency procedures for field quality control.
   b. Review requirements for supplementary hip, valley and ridge framing

1.6 CLOSEOUT SUBMITTALS

A. Provide project maintenance manuals.
1.7 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the structural system and the roof system with specified thermal properties.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Structural Loads: Provide enclosure system capable of handling the following loads:

   a. Insert structural loads, as determined by project’s structural engineer in subparagraphs below. Insert all loads in PSF, not wind speed. If drift load is applicable to the project, provide the necessary profile.

   b. Roof Live Load, on horizontal projected surface, minimum: 50 PSF

   c. Roof Snow Load, on horizontal projected surface, minimum: 50 PSF

   d. Base Wind Load, see structural design criteria, PSF factored per applicable Building Code 157 MPH ultimate, structure is 110’ above the ground.

1.8 DESIGN

A. Description: Enclosure System

1. Nominal Size: see plans

2. Aluminum Box Beam Size: as required by design

3. Eave Height: see plans and elevations.

4. Roof Pitch: see plans and elevations.

1.9 WARRANTY

A. Provide manufacturer's and installer's written warranty agreeing to repair or replace enclosure system work, which fails in materials or workmanship within one year from the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering, defects the insulated translucent sandwich panels and other components of the work.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site with factory installed shipping skids and lifting lugs.

B. Handle carefully to avoid damage to components, enclosures, and finish.

C. Manufacturer shall provide adequate protection of casing and openings to prevent dirt, insects, etc. from entering the unit during shipping and storage. The method of protection will be 8 mil shrink wrap applied at the factory before shipping.

D. Deliver enclosure system, components and materials in manufacturer’s standard protective packaging.

E. Store enclosure system panels; several inches above the ground, blocked and under cover to prevent warping in accordance with manufacturer’s storage and handling instructions.
PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Modular mechanical room enclosure shall be a factory-assembled module. The enclosure is required to be assembled at the plant, disassembled for shipping to the work site, then reassembled in the field.

B. Design and assemble units to ensure that each enclosure is engineered to withstand wind and seismic loads per ASCE 7-10 and IBC 2015 and the Structural Design Criteria on sheet S000, along with its own self-weights.

C. Design and enclosure assembly shall provide external single power point connections of electrical power to lighting systems and convenience power outlets as outlined within this specification.

D. Factory install all internal electrical components, conduits, electrical conductors, junction boxes, control tubing and piping. All conduits shall be EMT type and shall be properly supported and securely attached to units. Flexible conduit shall be liquid tight. Flexible metal conduit is not acceptable. Provide minimum four (4) - 2” round floor drains in sections not normally exposed to water. Provide sloped floors with minimum 8” x 8” sump in all sections exposed to water. Openings shall be carefully cut into the floor plate and continuously welded in place. Schedule 40 aluminum drain piping, no less than 2” in diameter, shall be insulated and routed to the exterior of the unit base and capped with a pipe cap.

E. All conduits penetrating the unit casing shall be sealed airtight.

F. Any sheet metal screws placed in unit casing for mounting tubing, conduit, etc., shall have a rubber washer or shall be embedded in silicone caulking.

G. All casing seams and joints shall be sealed air and water tight.

H. Piping sleeves shall be provided for all pipes, instrument lines and conduit passing through the unit floor. These sleeves must be at least 2” tall and welded to form a watertight seal.

I. Casing fastening bolts, screws or rivets shall be zinc plated for galvanized or aluminum construction, or type 304 stainless steel for stainless steel construction.

J. Flexible liquid type conduit shall be used at the section splits to facilitate the reconnection of conduit at time of unit installation. All wiring shall be coiled at the section splits for pulling through the conduit and termination in the control panel or main junction box at time of unit installation. All wiring shall be properly tagged with matching numbers labeled on the terminal strips in the control panel or main junction box to facilitate termination at time of unit installation.

K. Units to be supplied with heavy duty lifting lugs. Each section must have a minimum of four lifting lugs.
2.2 ENCLOSURE COMPONENT CONSTRUCTION

A. WALLS AND ROOF

1. Wall and Roof casings shall be double wall construction, insulated panel construction. Outer wall shall be a minimum of #20 ga. embossed aluminum formed into 12” wide standing seam panels. Each standing seam shall be 1 ½” in height and filled with sealant. The inner wall shall be a minimum of #18 ga. aluminum. Insulation shall be 2-inch, 3# density fiberglass for walls, roof and underside of floor.

2. Roof shall be sloped a minimum ¼” per foot with a gutter and downspout mounted on the low side of the unit.

3. All dissimilar materials are to be properly isolated.

B. PANEL CONNECTIONS

1. All panels shall be connected by means of grommeted tek screws on the exterior of the panel. A formed hat channel a minimum of #18 ga. aluminum shall be installed on the exterior of the inner liner and shall run horizontal around the unit. The hat channels will be installed, at a minimum, at the top, midpoint and bottom of the wall. The standing seam siding will attach to these hat channels. Where thermal break/no through metal conditions are required, these hat channels will be made of a non conducting extruded composite, such as CPVC or Lexan.

C. FLOORING

1. Flooring shall be 6” thick field poured concrete as indicated in the structural drawings. Under-floor structure is to be insulated with 4” polyisocyanurate foam insulation and covered with a minimum #22 ga. aluminum sheet metal.

2. No through metal is required, the floor shall be separated from the base by the use of a non-conductive composite, such as CPVC or Lexan.

D. PERSONNEL DOORS

1. Personnel doors shall be 3’-0” wide x 6’-8” where located on plan. Door frames shall be of welded, mitered extruded aluminum with a thermal break (if required). Door shall be made of insulated sandwich panel construction.

2. Doors shall have perimeter airtight, replaceable gasketing. Door sealing gaskets shall be rubber.

3. All doors shall be equipped with a latching system, which shall open from both sides of the door. The latches shall be Allegis composite handles with 304 stainless steel mechanisms. Doors shall be attached to the casing with a continuous stainless steel hinge.

4. All doors shall be installed to in direction of egress.

5. Doors to have 8” x 20” double pane, thermal wire reinforced safety glass viewing window.

6. Where thermal break/no through metal is required, a phenolic resin for thermal break shall be utilized.

7. Doors shall be as manufactured by Leaf, Cesco, AJ Doors, or equal.
E. ROLL-UP EQUIPMENT DOORS

1. Roll-up doors shall be 10'-0" wide x 12'-0" where located on plan. Door frames shall be of welded, mitered extruded aluminum with a thermal break (if required). Door shall be made of insulated sandwich panel construction.

2. Doors shall have perimeter airtight, replaceable gasketing. Door sealing gaskets shall be rubber.

3. All doors shall be equipped with a latching system, which shall open from both sides of the door. The latches shall be Allegis composite handles with 304 stainless steel mechanisms. Doors shall be attached to the casing with a continuous stainless steel hinge.

4. Doors to have 8” x 20” double pane, thermal wire reinforced safety glass viewing window.

5. Thermal breaks are required. Phenolic resin for thermal break shall be utilized or approved equal.

6. Doors shall be as manufactured by Leaf, Cesco, AJ Doors, or equal.

F. FRAME AND/OR BASE

1. Base shall be constructed from standard structural steel beams, channel and intermediate supports, adequately sized to prevent any deflection or sagging of the enclosure housing, or internal components during lifting, shipping, unloading or operation.

2. Provide each section with a minimum of four lifting lugs per shipping section attached to the structural steel base of the unit.

3. Provisions shall be provided to seismically attach the mechanical enclosure to the new elevated structural support steel provided by the structural engineer.

4. Paint completed frame and/or base with two coats of primer and one finish coat of machine gray enamel.

5. When two or more units are stacked on top of each other, the structural integrity of the base unit(s) shall be sufficient to support the upper operating unit.

6. Sealant shall be installed between panels at all joints, between panels and trim, and between panels and base channels to provide an airtight enclosure.

7. Sealant shall be non-sag, non-staining, permanently flexible, of highest quality, and recommended by its manufacturer for the intended application.

G. ROOF

1. Roof shall be constructed from standard structural steel beams, channel and intermediate supports, adequately sized to prevent any deflection or sagging of the enclosure housing, or internal components during lifting, shipping, unloading or operation.

2. Provide additional supports to adequately support the roof mounted equipment and personnel. Roof and structure shall be sized to handle a minimum of 50 lbs. per SF. Supports shall be no more than 2 foot on centers in all directions.

3. Sealant shall be installed between panels at all joints, between panels and trim, and between panels and base channels to provide an airtight enclosure.

4. Sealant shall be non-sag, non-staining, permanently flexible, of highest quality, and recommended by its manufacturer for the intended application.

5. Framed roof opening shall be provided to adequately support and accommodate roof curb and exhaust fan installations by mechanical contractor.
2.3 OUTSIDE AIR INTAKE OPENINGS

A. Air intake openings are to be arranged according to the project plans.

B. Intake openings shall be designed to prevent snow or rain from being pulled into the air supply house. Sizes of openings shall adequate for installation of louvers and dampers as specified on mechanical plans.

C. Louvers are to be designed for a gross intake velocity not to exceed 450 fpm and shall include a mesh screen mounted to the inside of the louver. The louver shall have a net free area greater than 58%. Blades are to be fabricated from extruded aluminum shapes.

2.4 ELECTRICAL / CONTROL

A. Electrical

1. Lighting and receptacles:
   a. Provide a marine type waterproof light fixture with 150-watt incandescent rough service bulb, rated for 125v, in each housing module capable of 10 foot candles minimum lighting.
   b. Provide 3 way light switches at each end of the unit. Switch to have a square toggle cover. If exposed to weather, switch shall be weatherproof.
   c. Provide a GFCI receptacle under light switch at fan section door. If exposed to weather, receptacle shall be weatherproof with a self-closing cover.
   d. Provide minimum ¾” conduit through casing wall for 120v power wiring to enter unit from a single point connection junction box on the exterior wall of the unit.
   e. Light switches and receptacles shall be rated for 20amp as manufactured by Hubbell or approved equal.
   f. Sockets shall be porcelain, medium base.
   g. Where lights are to be fed from the unit 480 volt panel, a separate 480 volt feed shall be installed ahead of the main disconnect. A warning tag shall indicate that this wire is not de-energized when main disconnect is de-energized. The 480 volt feed shall be run to an appropriately sized lighting center, that shall include a 480v to 120v transformer with the proper quantity and size of breakers to operate the lights and service receptacles.

2. Power:
   a. Install non-fused disconnect switches, as required for complete and operable system.
   b. Electrical components, devices, and materials shall be sized in accordance with NEC requirements for 40 degrees C operating conditions.
   c. All power wiring shall be tied into a single source such as a main control panel, panelboard, motor control center or power distribution block.
3. Wiring and Conduits:
   
a. All electrical wiring shall be installed in EMT conduit, minimum size of 3/4 inch. Use liquid tight flexible conduit at motors, transformers and any device subject to vibration and where EMT conduit is not applicable. However, each length of flexible conduit shall not exceed 48 inches.
   
b. Liquid tight flexible conduit shall be used across section splits to facilitate unit installation.
   
c. Separate conduit systems shall be provided as follows:
      1. Power Circuitry
      2. Lighting Circuitry
      3. Control and Instrumentation Circuitry
   
d. All conduit connections to boxes and fittings shall be supported not more than 12 inches from connection point. All conduit bends shall be supported not more than 12 inches from each change in direction.
   
e. Exposed conduits shall be securely clamped and supported with pipe hangers or galvanized one-hole pipe straps fastened to structure with bolts, screws, and anchors. The spacing of supports for horizontal runs of 3/4-inch conduit or larger shall be not more than 8 feet. The spacing of supports for vertical runs of 3/4 inch, and 1 1/4 inch conduits shall be not more than 7 feet. The spacing of supports for vertical runs of 1 1/2 inch or larger conduits shall be not more than 7 feet.
   
f. All unit wiring for external connections shall be terminated on the left hand side of the outgoing terminal blocks.
   
g. When multiple vertical rows of terminal boards are located in the same terminal box, a minimum of four inches clear space shall be provided between adjacent vertical rows.
   
h. Power and control and instrumentation wiring shall be separated from each other and shall not be terminated on the same terminal blocks.

PART 3 - EXECUTION

3.1 PREPARATION
   
A. Anchor Bolts shall be supplied and installed by the general contractor. Enclosure anchoring system will be as per manufacturer’s standards.

3.2 INSTALLATION
   
A. Enclosure manufacturer shall provide a factory trained supervisor to instruct and supervise the Contractor in rigging, and erecting. The price for such services shall be indicated in the unit manufacturer's quote.
   
B. After other trades have completed work on adjacent material, carefully inspect translucent panel installation and make adjustments necessary to ensure proper installation and weather tight conditions.
3.3 FINAL CLEANING

A. The outside and particularly the inside of the enclosure shall be thoroughly cleaned. Industrial grade cleaners can be used to remove construction dust. The entire unit shall be wrapped with 8 mils of shrink wrap and heated to maintain unit cleanliness standards for shipping.

3.4 UNIT SHIPMENT

A. The enclosure must be scheduled to ship with the manufacturer and the owner. These dates are to be determined and agreed upon by both parties.

3.5 WARRANTY

A. All work and workmanship is done by highly trained professionals and their workmanship is guaranteed for a period of one year. The warranty of all components will be the manufacturer's standard warranties serviced by the enclosure manufacturer.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 133423
SECTION 230000 - PROJECT SCOPE

PART 1 - GENERAL

1.1 SCOPE

A. The overall scope of this project is the replacement of a centrifugal water cooled chiller, cooling tower, chilled water pumps and condenser water pumps in the existing mechanical room located on the 7th level in the Institute of Psychiatry at the MUSC. A new chiller, chilled water and tower water pumps, normal and emergency power systems, cooling tower, and tower water piping systems are included as part of this contract. Removal of the existing chiller from the Institute of Psychiatry Building is included in the contract and includes the reclamation of refrigerant systems. Modifications to the existing equipment include relocation and/or re-routing of a portion of the chilled water and tower water lines. A more detailed, but not exhaustive, list of scope requirements are shown below. The contractor should review drawings and specifications carefully to determine the complete scope of the project.

B. Removal, demolition, and replacement of exterior walls, louvers, roofs, ceilings, floors, slabs, etc. required for the replacement of mechanical and electrical equipment, pumps, piping, control panels, valves, actuators, electrical equipment, conduits, etc.

C. New equipment doors in the cast exterior wall of the mechanical room on Seventh Floor of the Institute of Psychiatry Building to accommodate project equipment demolition, transfer and installation of new and existing equipment, including chillers, pumps, piping, electrical gear, etc.

D. Removal of one of the existing Institute of Psychiatry chillers, including refrigerant reclamation.

E. Installation of a new variable volume, high efficiency centrifugal chillers, primary chilled water pumps and tower water pumps with inertia bases, chilled water and tower water piping systems, valves and water specialties to complete the installation of the new chillers in the Institute of Psychiatry Building.

F. Electrical power and controls power for the new mechanical systems.

G. New variable speed drives to control the new primary variable volume chilled water pumps.

H. Removal, demolition, replacement, and new electrical equipment, components, conduits, devices, starters, disconnects, and systems to serve all of the new mechanical equipment, systems and controls.

I. Dust tight construction partitioning and negative pressure exhaust systems to prevent duct migration to occupied spaces outside the construction zones.

J. Modifications and alterations to the building structural steel systems to accommodate new equipment installations.
K. Water protection for all electrical equipment during construction.

L. Modifications to the existing chilled water piping systems.

M. Insulation, painting and labeling of all new piping systems and valves in the facility included in this contract.

N. Vibration and seismic restraints for all new equipment, devices, piping installed under this contract.

O. Provide appropriate personnel, equipment, chemicals, and procedures to flush and treat the water system to remove debris and substances that could impair the performance of the heat transfer surfaces. Water samples shall be taken and analyzed by a chemical treatment company approved by the Engineer and witnessed by a representative from the Engineer’s office. The system shall be certified as ready for use prior to any equipment being placed into service.

P. Start, test, adjust, balance and place into operation all systems. The building water distribution systems as indicated on the plans and the refrigerant exhaust fan system are to be balanced to provide the quantity of air and water as shown on drawings.

R. Control system for the new chiller shall be compatible with the existing chiller control system in the facility. Chiller plant controls and integration to Johnson Controls system and campus EMS system is included in this contract. Installation of new isolation valves to allow continued chiller plant operation during construction of this project.

Q. Project will have to be completed to ensure that existing Institute of Psychiatry chiller plant stays operational at all times.

R. The scope includes all associated mechanical, electrical, structural, and control work.

S. Install refrigerant monitoring system.

END OF SECTION 230000
SECTION 230200 - GENERAL REQUIREMENTS MECHANICAL

PART 1 - GENERAL

1.1 SPECIAL NOTES

A. Work under this section of the specifications shall be governed by requirements there under.

B. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.

C. This section applies to all sections of Division 23 of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical systems. Provisions of this section apply to all mechanical specification sections.

D. References: Refer to the General Conditions for the Contract, the Supplementary General Conditions for the Contract, and the Subdivisions of Division 1; all of which are contained in or referenced as a part of this Project Manual. Instructions relating to the overall operations of the Contractor, as they may apply and as contained in the referenced Subdivisions, will be equally applicable to his subcontractors, equipment and material suppliers and/or installers, and other persons or companies having work requirements, this project.

1.2 GENERAL REQUIREMENTS

A. Provide necessary labor, material, plant and equipment including materials not specifically mentioned, but necessary to complete the job in a neat, correct and workmanlike manner.

B. The drawings and specifications shall be considered as supplementary, one to the other, so that materials and labor indicated, called for or implied by the one and not the other, shall be supplied and installed as though specifically called for by both.

C. All electrical equipment shall be UL listed and all gas equipment is to be AGA certified.

D. All items shall be properly lubricated and in perfect operation upon completion of the project and prior to final acceptance by owner.

E. Contractor shall be held responsible for having visited job site and having familiarized himself with existing conditions prior to submitting bid. If any existing problems are identified, notify Architect in writing prior to submitting bid.

1.3 SCOPE

A. Refer to Section 011000 for a detailed description of the project scope.
1.4 SPACE CONDITIONS

A. All work shall fit the spaces available. Verify all dimensions of the work before commencing fabrication and/or installation. Minor deviations from the drawings required to conform to space conditions and to provide the required accessibility shall be made at no additional cost to Owner.

B. Only base manufacturer's equipment has been investigated and determined to meet necessary space conditions. It shall be the responsibility of the approved equal manufacturer and contractor to verify their suitability for use on this project.

1.5 DRAWINGS

A. The Plans are not intended to show all ductwork, pipes, valves, fittings, connections, and details of the work to be done. The piping, duct, and equipment locations shall be adhered to as closely as possible; however, any changes necessary to avoid columns, beams, lighting fixtures, ductwork, sprinkler piping, etc., shall be made at no additional cost to the Owner.

B. Conflicts in the plans and specifications where changes and alterations are necessary, or where exceptions are taken by the Contractor with regard to sizes, locations, and other details indicated on the drawings, they shall be discussed with the Architect and have his consent in writing before any changes are made. The Contractor shall confer with the Architect for the exact location of all openings into finished areas and all equipment and piping locations before proceeding with the work.

C. The drawings of this work were prepared in conjunction with the other trades and plans of the project and it shall be the Contractor's responsibility to provide himself with drawings of the other trades as required and to coordinate and schedule the work with the other trades.

D. Should any difficulties prevent the installation of the work as indicated, the proposed changes shall be submitted to the Architect in detail and must be approved in writing before the work may be performed.

E. All inverts, locations, and elevations on all piping, equipment, trenches, etc. shall be verified on the job site prior to the performance of any work that may be affected in any manner by said inverts, locations and elevations. Before construction of project starts, check location of proposed equipment and ductwork. Review other drawings for project, checking locations of structural elements, locations and sizes of chases, type and method of construction of roof, ceilings, walls, and partitions. Report to Architect and Engineers before start of construction any conflicts or unsatisfactory conditions. In no case shall Contractor proceed in uncertainty. No extra charge will be approved after start of construction for work resulting from failure to follow these instructions.

F. Where connections and drains are provided to serve specific pieces of equipment, it shall be the Contractor's responsibility to verify the exact location of the equipment connections and drains and no installation shall be attempted until exact locations have been established. This applies to all equipment regardless of who furnishes said equipment.
1.6 PERMITS, LICENSES, AND FEES

A. The installation of the systems covered by these specifications shall conform in strict accordance to all ordinances, codes and regulations of the State and DHEC and shall conform to all applicable requirements and recommendations of the N.F.P.A. These requirements are the minimum and shall be complied with at no additional cost to the Owner.

B. In the absence of local regulation and codes, on heating, ventilating, or air conditioning, or in items or circumstances not covered by local regulation and codes, all recommendations and requirements of ASHRAE, as set forth in the current editions of the applicable ASHRAE Guides, shall be met as well as all requirements and recommendations of NFPA 90A and the International Building Code.

C. Where requirements of the drawings and specifications exceed code requirements, the work shall be provided in accordance with the drawings and specifications. Any work provided contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.7 BID BASIS

A. Basis of Design: The design is based on equipment data furnished by a listed "Base" manufacturer. Only this base listed equipment has been verified by the A/E for compliance with the documents. There is no intent in these documents to necessarily use only "standard" products of the "Base" supplier nor any other supplier. Modifications and alterations of standard products may be required.

1.8 MATERIALS AND WORKMANSHIP

A. All materials and equipment shall be new and free from flaws and defects of any nature. Materials called for are to be considered as standard of quality; which however, implies no right on part of Contractor to substitute other materials and methods without written authority from Architect.

B. All work shall be performed by skilled mechanics, under competent supervision, employing latest and best practices of the trade. Work shall be installed in accordance with recommendations of ASHRAE Guide, and equipment manufacturer's installation instructions. In the event there is any conflict or doubt, consult Architect for clarification and approval.

1.9 SUBSTITUTIONS

A. Specific reference in the specifications to any article, device, product, material, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal" shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor in such cases may at his option, use any article, device, product, material, fixture, form or type of construction, which in the judgement of the Architect, expressed in writing prior to bidding as specified below, is equal to that herein named.
B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified, shall be submitted for approval to the Architect ten days before bids are taken. Requests shall be accompanied by samples, descriptive literature, and engineering information, as necessary to fully identify and appraise the product. No increase in the contract sum will be considered when requests are not approved. If the item is found to be equal, the Architect will issue an Addendum making it a part of the Contract Documents prior to bidding. After bidding, no further changes will be considered.

C. Contractor shall be responsible for determining that all products submitted for approval meet given space limitations and maintain all required clearances for proper access and service.

D. Being listed as an approved equal manufacturer means only that the listed manufacturer is basically a reputable supplier whose equipment will receive consideration if in accordance with all document requirements including space limitations and deliver. Being listed is not to be construed as indicating or implying that the supplier's product is assured of being acceptable for the project. The burden of developing a product to comply with the documents and of obtaining approval of the product rests solely with the Contractor and is his sole responsibility to substantiate their acceptability for installation on this project. If a substituted product is rejected due there will be no increase in contract sum to provide a compliant product.

1.10 SUBMITTAL

A. The Engineer will review and take appropriate action on shop drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be for general compliance with the design and with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviation from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been made.

B. Prior to submittal of shop drawings to the Engineer, the General Contractor and the Mechanical Contractor shall review and approve shop drawings. Shop drawings which have not been reviewed and approved in writing by the Mechanical Subcontractor will not be reviewed by the Engineer. Mechanical Contractor shall state in writing on shop drawings, any proposed deviations from contract documents. Such deviations, if not stated in shop drawing submittals, shall be the sole responsibility of the Mechanical Subcontractor. **Note: In addition to the General Contractor's approval and stamp, the first page of each shop drawing submittal must contain the words "APPROVED" or "APPROVED AS NOTED" and must be signed and dated by the Mechanical Subcontractor before the Engineer will review them.**
C. Review rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail; said review does not in any way relieve this contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.

D. After award of Contract, and before any materials of this Section are delivered to the job site, submit complete sets of Shop Drawings to Architect in accordance with the requirements listed below and in accordance with the provisions of the Architectural Section of these Specifications.

1. After securing tentative approval on all items pending shop drawing submission, the contractor shall submit for approval manufacturer's shop drawings of all equipment, and shop drawings to scale of all fabricated work furnished under this Section of the specifications including piping, ductwork, equipment layouts, supports and equipment foundation pad layout. Shop drawings shall be of scale large enough to clearly indicate all details of work. Mechanical rooms, boiler rooms, refrigeration plants, and fan rooms shall be submitted on a scale of not less than 1/4-inch equals one foot.

2. Where colors or finishes are specified for products, a sample showing the color or finish shall be submitted with the shop drawings.

3. Where high efficiency motors have been specified, submit certification of motor efficiency with shop drawings for each motor of one horsepower or greater.

E. Material List: Accompanying the shop drawings, submit a complete list of all materials proposed to be furnished and installed under this Section, giving manufacturer's name and catalog number, sizes, capacities, model numbers, accessories and other pertinent information for each item to indicate full compliance with drawings and specifications; this shall in no way be construed as permitting substitution except as specifically provided in the Architectural Section of these specifications. Every device or piece of equipment herein specified by model and manufacturer shall be submitted for approval. Partial lists submitted from time-to-time will not be permitted.

F. Mechanical/Electrical Coordination: Before equipment is ordered and after all motors, loads, controls, and other characteristics of equipment are known, the Contractor shall review the data shown on the Electrical drawings. Special attention shall be given to motor size, starters, means of disconnect, control wiring, etc. that are being furnished under the electrical section of the specifications. At the time of shop drawing submittal, the contractor shall by letter to the Engineer point out any discrepancies and describe the proposed corrective action.

1. Prior to start of construction, contractor shall submit a starter schedule for review by Engineers. This schedule shall contain equipment description, starter manufacturer and model number, starter accessories, control voltage and source of starter power and control circuitry.

2. No extra charge will be approved after start of construction for work resulting from failure of contractor to follow these instructions.
G. As-Built Drawings: Contractor shall maintain on the job site one complete set of the mechanical drawings for this project. All changes authorized by the Architect as to the location, sizes, etc., of piping, ductwork, and other mechanical equipment shall be indicated in red ink on the mechanical drawings as the work progresses. At the completion of the project, Contractor shall deliver a complete set of "As-Built" prints of the mechanical drawings to the Architect.

H. Control Drawings:

1. Before installation of controls, submit complete submittal data, including equipment specifications, control diagrams, schematic diagrams, internal connections, and sequence of operation to the Architect for his approval. Diagrams shall show all instruments, devices, tubing, etc. Set points and actions of instruments, operating ranges, and normal position of controlled devices shall be indicated. Operating sequence describing each system shall appear on the same drawing as the system's control diagram.

2. Wiring diagrams shall show conduit and wire sizes, transformers, fuses and correct schematic diagrams for each motor starter and magnetic contractor. Diagram shall be coordinated with the equipment manufacturers involved and shall show the terminal designations for all connections to the equipment and the manufacturer's approval obtained.

I. Manual: Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the Owner through the Architect two copies each of a Manual compiled in accordance with the provisions of the Architectural Section of these specifications; and also include in each copy of the Manual a copy of the As-Built Drawings, operating and maintenance instructions, approved control drawings, spare parts lists, name and address of local service representatives and all warranty certificates for new equipment.

1.11 ELECTRIC WORK

A. Electrical Contractor will provide the following for the mechanical equipment:

1. A source of power as required for each electric motor and for each electrical heating and cooling item of equipment installed under the mechanical contract, including final wiring connections to motor terminals or to terminals in a control panel mounted on each respective unit.

2. Circuit breaker protection as required for each electric heating and cooling item of equipment installed under the mechanical contract.

3. Wiring each electric motor and each electrical heating and cooling item of equipment (where applicable) through a magnetic starter or a magnetic contactor furnished by the Mechanical Contractor.

4. Wiring each constant speed ceiling exhaust fan through a wall switch furnished by the Electrical contractor.

B. All motors shall be provided with thermal overload protection either internally or at the starter and all electrical equipment shall be U.L. listed.
C. In the event Mechanical Contractor proposes to use any items of mechanical equipment which have sizes, numbers of electrical meters, or other electrical requirements different from those specified on schedules, drawing or elsewhere, Contractor shall be responsible for coordinating these changes with the Electrical Contractor and he shall reimburse the Electrical Contractor for all additional costs necessitated by these changes.

D. In general, the Electrical Contractor will do all power wiring for the mechanical equipment as described above, and the Mechanical Contractor shall do all control and interlock wiring, unless otherwise specified or indicated on drawings.

E. Consult electrical drawings for extent of electrical work provided for the mechanical equipment. Verify current characteristics with Electrical Contractor before ordering any equipment for this project.

F. Mechanical Contractor shall provide all other wiring not covered above, that is necessary for complete and operating heating and air conditioning systems for the building, including all control wiring, interlock wiring, conduit, relays, controls, starters, disconnect switches, circuit breakers, control conduit and outlet boxes, wiring of all applicable control items of equipment, and other electrical work as required.

G. All wiring shall be run in galvanized or sherardized rigid electrical conduit or E.M.T. where allowed under the electrical section of the specifications, and shall be concealed in finished areas and occupied spaces. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation. NO PLENUM RATED CABLE WILL BE ALLOWED ON THIS PROJECT.

H. The Mechanical Contractor shall provide power wiring from the breaker panel to all control devices including but not limited to control panels, valves, thermostats, dampers, flow switches and other devices requiring power for a complete and operating mechanical system.

I. All electrical work required under this Contract shall comply with the National Electrical Code, and shall meet all local requirements. All electric equipment shall bear UL labels.

1.12 GUARANTEES

A. In addition to the warranty and guarantees under the General Conditions of the contract the Contractor agrees:

1. To correct defects in workmanship, new materials, new equipment, and the operation of system for a period of one year from date of acceptance. Equipment and materials, repaired or replaced are guaranteed for one year following date of correction.

2. To repair any damage to building and equipment resulting from defects in workmanship, materials, equipment, and system operation.

3. To remove any item not specified or given approval and replace it with specified or approved item.

4. Any item submitted for approval that does not conform to these specifications shall have accompanying note of exception.

5. That the system as installed shall comply with code requirements.
PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials provided under this section of the specifications shall be new and of the best grade and quality. Materials and equipment manufactured outside of the United States will not be acceptable.

B. The approval of the Architect shall be obtained by the Contractor on all equipment and materials before any installation is made.

C. Equipment that is installed and then does not perform as represented by selection data or shop drawings shall be replaced with equipment that meets the job requirements and specifications at no additional cost to the Owner.

D. All equipment, materials, and work indicated on the drawings or as specified hereinafter is intended to be installed in a manner conforming to the best engineering practices and all equipment is intended to be complete in every respect to satisfy the job requirements and this specification. In the event any material or equipment is indicated to be used or installed contrary to the manufacturer's recommendations, or if any part, control accessory or auxiliary item required for satisfactory and proper operation and performance of the material and/or equipment is not indicated or specified, it shall be the Contractor's responsibility to notify the Architect in writing prior to installation. In the event the Contractor fails to give such notice, he will be required to correct the work and/or furnish items omitted (in the performance of his work) at no increase in the contract sum.

E. Upon request from the Architect, the Contractor shall furnish to the Architect a certification on all materials and equipment so designated by the Architect. The certification shall be made by the manufacturer of the material and/or equipment; shall be signed by an official of the manufacturing concern; and shall state that the drawings, specifications, and project requirements have been thoroughly studied by the manufacturer and that the proposed material and/or equipment is unconditionally guaranteed to operate and/or perform properly as applied.

PART 3 - EXECUTION

3.1 UTILITY CONNECTION AND MODIFICATIONS

A. It shall be the Contractor's responsibility to determine all requirements regarding utility services to the building. The Contractor shall verify the exact locations of stubs provided.

3.2 PROTECTION

A. The Contractor shall provide adequate protection to all materials, equipments, fixtures, etc. provided under this section of the specifications to prevent damage of any nature. The Contractor shall be required to remove and replace, at no additional cost to Owner, any item showing any sign of damage of any nature that cannot be restored to its new condition and appearance. Grinding and polishing may be used in the restoration of damaged equipment and materials when approved by the Architect.
3.3 CUTTING AND PATCHING

A. The Contractor will do all cutting and patching and construction of chases within building for this installation.

3.4 PENETRATIONS AND CURBING

A. Contractor shall provide framed openings in roof and walls as required for exhaust fans and louveres. Contractor shall coordinate sizes and locations of these and all other necessary penetrations well in advance.

B. Contractor shall provide all roof curbs for this installation and will flash all roof curbs and penetrations as detailed on drawings.

3.5 MECHANICAL - ELECTRICAL COORDINATION

A. Mechanical equipment, piping, and ductwork shall be installed with clearances to electrical switchboards, panel boards, power panels, motor control centers, and transformers. The clearances shall be the greater of the requirements of the latest editions of the NEC or a minimum of 3'-6" in front of the equipment which ever is greater. Equipment, ductwork or piping shall not be installed directly over the electrical gear and not less than 3'-0" horizontally from the top of the electrical gear.

3.6 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall acquaint and instruct the Owner's representative with all details of performance, operation, and maintenance of the systems. In addition, the contractor shall furnish two copies of a brochure to the Owner through the Architect, which shall contain printed operating and maintenance instructions, parts list, control diagram, etc., including a list of spare parts and any special tools recommended by the equipment manufacturers to be stocked by the Owner. The manuals shall include a complete set of all approved shop drawings furnished under this section of the specifications.

B. The basis of Owner's instructions shall be written for inclusion in the maintenance and operating instructions data specified above. Obtain certificates, signed by the Owner's representative, that these instructions have been received and understood.

3.7 CLEANING

A. The Contractor shall keep the job site clean, removing all debris and unused material as they occur. At the completion of the work, the Contractor shall thoroughly clean all materials and equipment provided as part of the work.

B. Prior to testing and adjusting, all new piping systems, including all components of systems, shall be thoroughly cleaned inside and out.

C. All piping shall be chemically cleaned prior to final filling and connection to air handlers.
D. Painting of the mechanical equipment shall be as specified under other sections of the work. Removing loose scale, rust, drippings, dirt, etc. in preparation for painting shall be done under this section of the specifications.

E. Prior to acceptance of the building, thoroughly clean all exposed portions of the HVAC installation, removing all labels and all traces of foreign substances, using only a cleaning solution approved by the manufacturer of the item being cleaned. Caution should be taken to avoid damage to all finished surfaces.

3.8 START-UP

A. The Contractor shall place the systems in full operation before testing begins. Contractor shall make corrections in the system, including furnishing and installing drives, motors, dampers, valves, etc., if required to balance the systems. All such corrections shall be included in the Contractor's base bid and shall be accomplished at no additional cost to the Owner. All piping shall be tested before covered with insulation or being concealed.

END OF SECTION 230200
SECTION 230300 - PRESSURE TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section includes the pressure testing of all air conditioning systems and includes requirements common to all the mechanical systems. Provide all labor, tools instruments, etc. as required to completely test the systems.

B. Other sections of these specifications are a part of this section. Refer to all other sections for a complete description of the work. Work, conditions, and materials specified in other sections and not duplicated in this section includes, but is not limited to the following:

1. Mechanical General Provisions.
2. Basic Materials and Methods.
3. Refrigeration.

C. All work provided under these specifications shall be subject to constant inspection and final approval of the Architect and all Code authorities having jurisdiction. Tests, in addition to these specified herein, required to prove Code compliance shall be provided as required by the Authorities without additional cost to the Owner. All work found to be defective or indicating leakage shall be repaired or replaced with new materials, as directed by the Architect. Tests shall be repeated until all work is proven tight.

1.2 QUALITY CONTROL

A. All tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the Architect for approval.

1.3 NOTIFICATION

A. The Engineer shall be notified a minimum of 7 days prior to all tests.

B. The Code Authorities having jurisdiction shall be notified prior to all tests.

PART 2 - PRODUCTS

2.1 PROVIDING EQUIPMENT

A. Provide all material, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.
PART 3 - EXECUTION

3.1 PIPE TEST

A. All water piping shall be proven tight by a hydrostatic pressure test of 1-1/2 times the normal working pressure of the system, but in no case less than 200 psig for a period of not less than 4 hours. The piping shall hold the pressure without change except that change due to temperature change.

3.2 EQUIPMENT TEST

A. Equipment in the piping system shall be subjected to hydrostatic pressure tests equal to the maximum non-shock working pressure of the equipment and shall hold the pressure for not less than 4 hours.

3.3 REFRIGERATION SYSTEMS

A. The refrigeration systems shall be proven tight in accordance with the manufacturer's recommendations.

END OF SECTION 230300
SECTION 230500 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work described in this section includes construction materials and methods of installing equipment common to all mechanical systems. Provisions of the section apply to all mechanical specifications sections.

PART 2 - PRODUCTS AND METHODS

2.1 FLASHING

A. Ductwork and HVAC Equipment: Cap flashing for all ducts and other types of ventilating equipment which pass through or mount on the roof shall be furnished and installed under this section of the specifications. The material shall be of the same materials as the ducts, etc. to which it shall be fastened unless otherwise noted. The cap flashing shall be made tight to the duct, waterproofed, and extended over the base flashing and down the side for not less than 4 inches. The cap flashing shall be formed to provide a spring action against the base flashings. In cases of dissimilar metals between the cap and base flashings, an isolation membrane shall be installed to prevent electrolysis.

B. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the Architect.

2.2 PIPE SLEEVES

A. All pipes passing through walls, floors, ceilings, all fire rated partitions, etc. shall be provided with pipe sleeves made of galvanized steel pipe unless specifically noted otherwise. Sleeves through partitions and walls shall be of the same length as the wall thickness. Sleeves set in concrete slabs shall be set flush with the underside of the slab and shall extend 1/2 inch above the finish on top of the slab. Where sleeves are in fire rated construction, the voids between the sleeves and the piping passing through insulated piping shall be of sufficient size to allow insulation to pass through the sleeve freely. Where pipes pass through walls below grade or through any floor slabs, the space between the pipe and sleeve shall be finished caulked water tight with G.E. Silicone caulking.

B. At the Contractor's option sleeves 8 inches in diameter and larger may be formed of 16 gauge galvanized steel with welded butt joints. The metal finish shall be restored after welding.

2.3 FIRESTOPPING MATERIALS

A. Where pipe, ducts, conduit, wiring, or other mechanical equipment passes through fire rated walls, floors, or partitions with ratings of one-hour or greater, firestopping materials shall be placed in the voids between the equipment and the rated building material. Sleeves in rated construction shall have voids between sleeves and duct or pipe filled with firestopping materials.
B. Firestopping Materials shall have a fire rating equal to or greater than the construction penetrated. Firestopping material shall not produce toxic smoke when exposed to flame. Firestopping shall be unaffected by vibration, normal usage, and shall not deteriorate with time.

C. Firestopping materials shall be Chase-Foam as manufactured by Chase Technology Corp. or Silicone RTV Foam (3-6548 Silicone) as manufactured by Dow Corning or 3M "CP-25" caulk system. Where permitted by Code, fire rated mineral wool may be used for applications approved by the Architect. All fire stopping systems shall be installed in strict compliance with manufacturer's instructions for compliance with UL listings.

D. Firestopping in the mechanical room [and elevator machine room] shall be recessed 3/4-inch on both sides and shall be sealed on both sides with 3/4-inch of acoustical sealant.

2.4 PENETRATIONS AND CURBING

A. General Contractor shall provide framed openings in roof and walls as required for exhaust fans and louvers. Mechanical Contractor shall coordinate with General Contractor and provide General Contractor with sizes and locations of these and all other necessary penetrations well in advance. Failure to do so will result in Mechanical Contractor bearing cost of this phase of the work.

B. Mechanical Contractor shall provide all roof curbs for this installation and General Contractor will flash all roof curbs and penetrations as detailed on drawings.

C. Mechanical Contractor shall provide all roof equipment support rails for this installation and General Contractor will flash all support rails and penetrations as detailed on drawings.

D. Curbs shall be welded galvanized steel construction minimum 18 ga. with wood nailer, 1-1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be Creative Metals, Inc. Series CSSF, Conn-Fab, or approved equal. Curbs shall be compatible roof system. Verify roof construction and pitch prior to ordering curbs. Provisions shall be made within curbing penetrations for routing of power wiring and control wiring to equipment to prevent the necessity of a second roof penetration for this purpose.

E. Equipment Support Rails shall be welded galvanized steel construction minimum 18 ga. with wood nailer, 1-1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be Creative Metals, Inc. Series ESSSF, Conn-Fab, or approved equal. Support Rails shall be compatible roof system. Verify roof construction and pitch prior to ordering rails.

F. Where walls are penetrated for louvers, ducts, or vents, appropriate lintels shall be provided to support structure and shall comply with the requirements of the structural drawings and specifications.
2.5 FLOOR, WALL AND CEILING PLATES

A. General:

1. Where exposed to view, all piping or duct passing through or into floors, walls, partitions, and ceilings shall be provided with escutcheon plates of flanges. The Plates or flanges shall fit snugly around the pipe, or the pipe insulation for insulated lines, and shall cover completely the pipe opening and sleeves. Plates shall be fabricated of minimum 16 gauge galvanneal as appropriate to allow field painting. All plates shall be painted to match surrounding finish.

B. Unfinished Areas:

1. In unfinished areas, the plates or flanges shall be constructed of not less than 16 gauge galvanized sheet metal. Equipment rooms with furred ceilings will be considered as unfinished areas.

2.6 ACCESS PANELS

A. Access panels shall be provided for access to all equipment, valves, piping, dampers, etc. furnished under this section of the specifications and requiring access. Dampers with operating control through the ceiling will not require access. The panels shall be located as indicated on the drawings and/or as required for adequate access. The exact locations of the access panels shall be as approved by the Architect.

B. Walls and ceilings: Contractor shall furnish and install steel doors in sidewalls, in walls of chases, in accessible chases, and other locations as indicated or required for ready access to service valves, balancing valves, automatic air vents, balancing dampers, and other items as applicable. Access doors shall be a minimum of 24" x 24" in size where applicable, and shall be furnished with screwdriver operated cam lock doors and a gray prime coat finish. Access doors shall have the same fire rating as the walls, floors, or ceilings in which they are installed. Access doors shall be Miami-Carey Co. Model HP and (as applicable) or approved equal.

C. All panels located in fire rated walls or partitions shall be 1-1/2 hour B rated doors.

D. Ductwork: Furnish and install steel access doors where indicated and/or required for access to motor operated dampers, controls, filters, louvers, fire dampers, and any other operable devices. Access doors shall be minimum 18" x 18" in size and shall be fabricated of minimum 24 gauge galvanized steel hinged to a fastening device to give an air tight closure on neoprene or felt gasket. Doors for insulated duct shall be double panel construction with 1" rigid insulation material between metal panels. Access doors shall be Ruskin AD-1275, Series ADH-22 or approved equal.

E. Suppliers of Comparable Products: Krueger, Miami-Carey, Ruskin.

2.7 PAINTING

A. All factory applied finishes on equipment and materials that are damaged in any fashion shall be restored to their original finish in a manner as approved by the Architect.
B. Where the Interior of any duct is exposed to view or can reflect light as viewed from a habitable space the interior surfaces shall be primed and painted flat black or as otherwise approved by the Architect.

C. Where colors or finishes are specified in this section of the specifications to match adjacent surfaces and the colors or finishes of the product installed do not match the contractor shall repaint or refinish as required to accomplish the desired effect, as approved by the Architect.

D. All finish painting shall be performed under another section of the specification, except as specified otherwise in this section of the specification.

E. Mechanical Contractor shall paint all exposed piping, both insulated and uninsulated that is installed under his contract. Refer to Architectural Section and piping specifications for painting specifications.

2.8 EXCAVATION AND BACKFILLING

A. The Contractor shall carefully plan the excavations to avoid existing trees and plants and shall not approach too close to footings and foundation. Exact locations of excavations to be approved by the Architect before performing work. The excavation shall be only wide and deep enough to provide for the piping, and other sub-grade construction. Shoring shall be provided and used when the ground and/or the depth of the excavation warrants same.

B. The piping shall rest on a continuous and firm grade. Holes shall be cut in the bottom of the excavation for pipe bells.

C. Where rock is encountered the rock shall be removed to a depth of 6" below the desired depth and replaced with suitable earth.

D. Backfilling shall be started only after the piping has been completed, tested and inspected. The backfill shall be free of rocks and debris and shall compacted as the excavation is filled. The Contractor shall take ample precaution to prevent damage to the piping. The compaction of the backfill shall be the same as the adjacent area as approved by the Architect, unless otherwise indicated.

2.9 OUTDOOR UNIT SUPPORTS

A. Units on roof: Mechanical Contractor shall provide equipment support rails for each outdoor unit located on roof. Equipment support rail shall be as specified here-in. Mechanical Contractor shall coordinate with General Contractor on support rail placement to insure proper support and installation.

2.10 STRUCTURAL ATTACHMENTS

A. Concrete fasteners shall be self-drilling type, Locke Mfg. Co. "Bull Dog", Phillips "Red Head", or Diamond "Blue-Cut".

B. Mechanical Contractor shall provide all supplementary steel, framing members, beam clamps, hanger rods, etc., as required to properly support equipment and ductwork.
C. Hanger rods shall be selected to safely carry the load to be supported and shall not be less than the diameter listed by the hanger manufacturers for the specific size hanger used.

D. Attachment:

1. Piping and equipment suspended from steel construction shall be suspended from beams from the panel points of the bar joist only. When the hanger point is not directly below a structural member of a joist panel point, supplementary supporting steel shall be provided to receive the bridge across the structural member of a joist as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.

2. Hangers and supporting steel shall be attached to new concrete construction with continuous metal inserts designed to be used in ceilings, walls, or floors. In no case shall the load imposed on an insert exceed the manufacturer's recommended loading.

3. Hangers and supporting steel shall be attached to existing concrete structure, using concrete drill anchors at location and in a manner as approved by the Architect. Anchors shall not be loaded beyond their published ratings.

E. Support ducts from building structure with galvanized steel hangers to each side of duct. Hangers for ducts up to 60 inches maximum side dimension shall be 1" X 1/8" galvanized steel band. Hangers for larger ducts shall be 1-3/8" X 1/8" galvanized steel band. Space hangers on 8 foot centers with three hangers at each branch or take-off.

F. Steel pipe passing through a concrete slab on grade shall have modular expanding seals between pipe and sleeve. "Link-Seal" or an approved equal.

2.11 FOUNDATIONS, HANGERS, AND SUPPORTS

A. The Contractor shall provide all necessary hangers, supports, bracing, accessories, etc. required for proper installation of the work. Pipe hangers shall be spaced close enough to maintain proper grade and prevent sagging, but in no case shall the hanger spacing be greater than specified hereinafter. Special care shall be taken in supporting piping subject to expansion and contraction so that the piping does not become improperly aligned or anchored.

B. Unless specifically indicated otherwise, all concrete foundations and all structural steel, other than the building structure or special supports provided under another section of the specifications, required for proper support of piping, equipment, and materials provided under this section of the specifications and shall be furnished and installed under this section of the specifications and shall comply in strict accordance with all requirements of the Structural and/or Concrete Sections.

C. All supplementary steel exposed to the weather shall be hot-dipped galvanized.

D. Unless otherwise indicated, all floor mounted equipment located in the Equipment Room and spaces shall be mounted on 4" high concrete bases extending 6" beyond the bases of the equipment in each direction. Concrete shall be reinforced with No. 4 steel rods spaced 12" on center in both directions, except that steel in pump bases shall be on 6" centers.

E. Refer to Section 23 05 48 for seismic restraint requirements.
2.12 ELECTRICAL

A. All motors required for all equipment furnished under this section of the specifications shall be provided under this section of the work. Two speed motors shall be two winding type unless otherwise indicated. Unless otherwise indicated under the Electrical work or on the Mechanical Drawing, motors smaller than 1/2 HP shall be for 115 volts, single phase, 60 cycle power, and motors 1/2 HP and larger shall be single or three phase 60 cycle power as indicated on equipment schedules.

B. All motor starters, both manual and magnetic, and pushbutton stations required for motors furnished under this section of the specifications shall be provided under this section of the work unless specifically noted or indicated or otherwise in the Electrical section. All starters shall have "HAND-OFF-ON" switches and auxiliary contactors. Control transformers shall be provided as needed to meet control requirements. All two-speed starters shall be for two winding motors and shall have decelerating relay between high speed and low speed. All starters shall have compelling low speed start relay. All starters shall be installed under the Electrical Section of the specifications, unless furnished as an integral part of the equipment. All starters shall be of the same manufacturer as the starters furnished under the Electrical Section, except starters for water chillers may be of a different manufacturer. Coordinate with the Electrical Section.

C. Motors one horsepower and larger, including those used for pumps, air units, fans, etc. shall be designed in accordance with NEMA Standard MGI, Design B, Class B or F insulation for 40 degrees C temperature rise. The motor power factor at full load and rated voltage for motors with greater than 1 HP output shall be at least 0.85. Power factor shall be as determined by IEEE Standard 112A Method B. Apparent efficiency (Nominal Efficiency x Power Factory = Apparent Efficiency) shall meet or exceed the ASHRAE 90 energy standards.

D. All power wiring shall be provided under the Electrical Section of the specifications, unless specifically noted otherwise in this section of the work. Power wiring between starters and applied equipment motors shall be provided under the Electrical Section. Power wiring that is furnished under the Electrical Section to Packaged Equipment such as rooftop units, condensing units, electric heating equipment, packaged house pumping systems, etc. shall consist of a single point connection and shall terminate with the connection to the units shall be furnished as part of the package or shall be furnished under the Mechanical Section of the work.

E. All electrical devices and equipment including, but not limited to, all motors, starters, relays, pushbuttons, wiring, etc. provided under this section of the work shall comply in all respects with all requirements of the Electrical Section of the Specifications. Refer to the Electrical drawings for the project to determine the extent of Electrical wiring provided for support of Mechanical systems. All miscellaneous power wiring and all control wiring not indicated on Electrical drawings shall be provided by the Mechanical Contractor as part of Division 23 scope.

F. Identification labels shall be provided for each starter, control device, etc. showing the instruments function. Labels shall be in accordance with the requirements for labels as specified under the Electrical Section of the specifications.
G. All control wiring shall be provided under this section of the work, unless specifically indicated otherwise under the Electrical Section of the specifications.

H. Each manufacturer shall certify in writing to the Engineer that the equipment furnished has high efficiency motors as specified hereinbefore. The certification shall state motor HP, motor manufacturer, power factory and efficiency.

END OF SECTION 230500
SECTION 230503 - PIPE & PIPE FITTINGS

PART 1 - GENERAL

1.1 The work under this section includes furnishing and installing all pipe and fittings required for the project.

1.2 Refer to other sections for all additional pipe and fittings specifications:
   A. Refrigerant Piping
   B. Valves
   C. Pressure Testing

PART 2 – PRODUCTS

2.1 CHILLED WATER and HOT WATER PIPING
   A. Drains: Unless otherwise indicated, drains from mechanical equipment including unit condensate drains and equipment room drains shall be type "M" hard drawn copper tubing conforming to ASTM A-88, assembled using long radius pattern wrought copper solder fittings.
   B. Relief Valve Discharge Lines: Piping shall be the same as specified for the medium being relieved, unless otherwise indicated.
   C. Insulate all chilled and hot water piping as specified in section 230700 of these specifications.
   D. Piping 2-1/2 inch and larger: Aquatherm thermoplastic piping, fittings, and valves or approved equal.
      1. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. All pipe shall be made in a three layer extrusion process. Domestic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
      2. Pipe shall be Aquatherm, Climatherm or Climatherm Faser or approved equal.
      3. Fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
      4. Fittings shall be Aquatherm, Climatherm or approved equal.
      5. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or workmanship. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or workmanship.
6. Valves shall be manufactured in accordance with the manufacturers specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

7. Valves shall be Aquatherm Climatherm or approved equal.

8. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

9. Insulate all Aquatherm piping as specified in Section 230700 of these specifications.

2.2 PIPE FITTINGS

A. Copper Pipe: Wrought copper, solder type fittings, suitable for the temperature and pressures to be encountered and for the solder or brazing specified. Elks shall be long radius pattern. Flare connections to equipment will be allowed only where required. Unions shall be Nibco No. 633 wrought copper with copper-to-copper solder joints.

G. Pipe Joints:

1. Copper Pipe & Tubing: Copper joints shall be made with a wire type solder applied in accordance with the manufacturer's recommendations. No paste solder or flux solder will be allowed. Copper joints underground, under floors on grade, or concealed in chases shall be brazed with silver solder. Copper joints exposed above the floors on grade or readily accessible above removable ceilings shall be made with 95-5 wire solder or brazed with silver solder. Connections of copper to ferrous piping or equipment shall be made with dielectric couplings and proper adapters. Solder joints at valves shall be made with 95-5 solder only. Flare connections to equipment will be allowed where required. Ends of all pipe and tubing shall be cut square and reamed smooth. Ends of tubing and pipe and cups of fittings shall be cleaned of oxides by mechanical means and lightly fluxed as soon as possible with a non-corrosive paste type flux. When inserting pipe or tubing into fitting a slight twisting motion shall be applied to spread flux.

2. Mechanical Joints: Pipe ends shall be square cut and reamed of any burrs. Clean, sharp grooves shall be cut into pipe and the mechanical couplings and fittings shall be installed in strict accordance with the manufacturer's recommendations.

3. Gauge Ports: Gauge ports shall be .25 inch brass pipe

2.3 PIPE HANGERS AND SUPPORTS

A. The contractor shall furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

B. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate strength of the support. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the contractor shall submit a certification stating that such requirements have been complied with.
C. Submit to the Engineer for approval shop drawings of all items to be furnished under this section.

D. Submit to the Engineer samples of all materials specified herein if requested. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact.

E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties and be in accordance with MSS SP-58.

F. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.

G. Pipe hangers and supports shall be as manufactured by B-Line Systems, Inc. or equal by PHD, Grinnell, or Fee and Mason. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

H. Hanger rods, nuts, and bolts shall be cadmium plated in mechanical rooms and elsewhere where exposed. Hardware concealed above ceilings may be standard black steel.

I. Supports outside of building shall be galvanized construction.

J. Pipe Hangers and Supports for Metal Pipe:

1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts as follows:

K. Hangers:

1. All hangers and supports shall have some form of adjustment available after installation. Hanger material shall be compatible with the pipe material.
2. Hangers for steel pipe shall be B-Line Systems, Inc. figures B3100, B3102, B3170, and B3173 or equal. B-Line Systems, Inc. figures B3174 and B3198 or equal are acceptable for use on piping 2 inch and smaller.
3. Hangers for copper tubing shall be B-Line Systems, Inc. figures B3104CT, B3170CT, B3173CT, and B3198CT or equal. Felt isolator pads may be used on carbon steel hangers supporting stainless steel pipe or copper tubing.
4. Piping hangers shall be installed around the outside of the insulation with protective shields. Vapor barrier jackets shall not be broken by hanger rods.
5. Support long horizontal runs of insulated steel piping subject to 1/2" or more longitudinal thermal expansion with B-Line Systems, Inc., figures B3110 or B3114 roller hangers with a figure B3160 series protection saddle or equal. Cast iron rollers shall not be subjected to temperatures above 450°F.
L. Hanger Rods:

1. Hanger rods shall be B-Line Systems, Inc. figures B3205 and ATR or equal.
2. Hanger rods shall be subjected to tension only. Lateral and axial movement shall be accommodated by proper linkage in the rod assemble.
3. Hanger rod diameters shall be based on MSS SP-69 Table 4.

M. Concrete Inserts:

1. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers and shall be as manufactured by B-Line Systems, Inc. or equal and shall be as follows:
   a. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be B221, B321, or B521 by B-Line Systems, Inc. or equal.
   b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter. Inserts shall be figures B2505 thru B2508, B2500, or B3014 by B-Line Systems, Inc. or equal.

N. Welded Steel Brackets:

1. Wall or column supported pipes shall be supported by welded steel brackets equal to B-Line Systems, Inc. figures B3063, B3066, and B3067 or equal as required for pipe sizes up to and including 20" diameter.

O. Stanchions:

1. Floor supported pipes 3" and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.
2. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size base stand. Supporting pipe shall be of schedule 40 steel pipe construction. Each base stand shall be secured to the concrete floor by expansion bolts. Adjustable saddle supports shall be equal to B-Line Systems, Inc. figure B3093 with B3088T or B3090 with B3088.

P. Riser Clamps:

1. Riser piping shall be supported independently of any connected horizontal piping of possible. Provide supplementary steel or concrete supports for clamps. The clamps shall not be supported by the sleeves.
2. Support all vertical runs of ambient piping at each floor or as specified with B-Line Systems, Inc. figures B3373, B3131, B3373CT as required or equal.
Q. Pipe Clamps:
   1. Where flexibility in the hanger assembly is required due to horizontal pipe movement, use pipe clamps. For non-insulated pipe use B-Line Systems, Inc. figures B3140 or B3142 or equal. For insulated pipe use B-Line Systems, Inc. figures B3144 or B3146 or equal.

R. Trapeze Hangers:
   1. Strut channel trapeze hangers shall be used to support parallel piping. Pipe racks or stanchions fabricated with strut channel shall be used in areas of multiple pipe runs. Strut clamps, straps, and rollers will be used to maintain proper alignment. Strut shall be B22 or heavier as required as manufactured by B-Line systems, Inc. or equal. Clamps and straps shall be B2000 series or B2400 series by B-Line Systems, Inc. or equal. Rollers shall be B-Line Systems, Inc. figures B218, B219, B379, B479, or B3126 or equal.

S. Saddles:
   1. Pipe covering protection saddles shall be used in conjunction with all insulated cold pipe lines. All saddles shall be centered on the piping and in the hangers.
   2. Saddles for all insulated piping shall be galvanized sheet metal saddle shields of adequate size to cover the bottom 120 degrees of the pipe insulation. The shields shall be properly curved to evenly contact the outside circumference of the insulation and shall have rounded corners (1/2" radius). The length of the shields shall be as recommended by the pipe insulation manufacturer for the pipe size, insulation thickness and hanger spacing, but in shields shall be constructed of sheet metal of gauges not less than that listed below:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Min. Gauge</th>
<th>Min. Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up thru 3&quot;</td>
<td>18 gauge</td>
<td>12&quot; long</td>
</tr>
<tr>
<td>3-1/2 thru 5&quot;</td>
<td>16 gauge</td>
<td>16&quot; long</td>
</tr>
<tr>
<td>6&quot; and 8&quot;</td>
<td>14 gauge</td>
<td>20&quot; long</td>
</tr>
<tr>
<td>10&quot; and 12&quot;</td>
<td>12 gauge</td>
<td>24&quot; long</td>
</tr>
</tbody>
</table>

2.4 IDENTIFICATION OF PIPING

A. Label all piping in Equipment Rooms, above "Lay-In" type ceilings and all other accessible locations. Pipe markers shall conform with Scheme for Identification of Piping Systems (ANSI A13.1-1956).

B. Each marker shall show the name of the fluid in the pipe and a directional flow arrow, both superimposed on one of the five basic background colors. Pipe markers shall be installed at each service valve, at each mechanical item of equipment, at 20 foot intervals on horizontal runs of piping, and at midpoints of risers on vertical piping.

C. The identifiers shall be plastic strips on which the name of the service shall be printed. The identifiers shall be installed with an adhesive which will adhere to the pipe or insulation without deteriorating. Each piping system shall have a different color code marking. Colors shall be submitted for approval. Identification markers shall be applied over the insulation on insulated pipe. The identifiers shall be Brady or Seton self-sticking pipe markers and combination arrow tape meeting the requirements of ANSI standards. Where approved by Engineers stenciled labeling may be accepted.
PART 3 - EXECUTION

3.1 PIPING shall be installed and connected to the equipment essentially as indicated on the drawings, in a neat and workmanlike manner. Unless specifically noted otherwise, all piping shall be concealed above ceilings and in chases.

3.2 ALL PIPING and equipment shall be supported by the building structure. Unless specifically noted otherwise, no piping or equipment shall be supported from ductwork, other piping, plenum construction or other equipment.

3.3 ALL PIPING shall be installed and arranged to allow free movement to the piping due to expansion, contraction, building movement, etc. without putting excessive stress or strain into the piping or equipment. All piping, risers, runouts, etc. subject to deflection by expansion and contraction shall be cold-sprung 50% of the deflection required to be absorbed. All sleeves and other openings in the construction shall be of sufficient size and spaced so as to allow for the necessary pipe movement without undue stress on piping. Risers shall be free to travel as required with the horizontal piping. Piping runouts to and from risers shall be absorbed and still maintain the specified pitch for the runouts and piping to and from the risers.

3.4 PIPING and equipment suspended from steel construction shall be suspended from beams or from the panel points of the bar joist only. When the hanger point is not directly below a structural member or a joist panel point, supplementary supporting steel shall be provided across the structural members or bridge joists as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.

3.5 ALL VERTICAL PIPING shall be installed plum and true. Horizontal piping specified to be graded shall be installed at a straight and uniform grade without pockets. Horizontal piping not specified to be graded, shall be installed in a straight and true manner.

3.6 ALL PIPING SYSTEMS shall be arranged to drain to one or more low points. Each low point shall be equipped with a hose and valve drain connection.

3.7 UNIONS and/or companion flanges shall be provided at all equipment connections and elsewhere as indicated on the drawings or as required for easy removal of equipment.

3.8 WATER PIPING

A. Piping shall be graded upward in the direction of flow not less than 1" per 40 feet. The runouts shall be graded in a manner to prevent the formation of air traps when the mains expand and contract. Reductions in pipe size shall be accomplished by an eccentric reducer with the flat side on top. Manual air vents shall be installed at the ends of mains, at all high points in the system, and elsewhere as indicated on the drawings. Runouts and branch lines shall be connected to the underside of mains unless indicated otherwise.

3.9 DRAINS

A. Condensate and equipment drains shall be graded downward in the direction of flow not less than 1/4" per foot. Unless otherwise indicated, the drains shall spill into floor drains, hub drains, or on grade in a manner as approved by the Architect.
3.10 RELIEF VALVE DISCHARGE LINES

A. Lines shall be installed to drain the entire relief line. Relief lines shall be supported in a manner to prevent any weight being placed on the relief valve. All relief lines shall have a plain section of pipe at the discharge point without threads.

3.11 FILLING, CLEANING, AND FLUSHING ALL WATER SYSTEMS

A. Prior to beginning chemical cleaning and final treatment, the Contractor shall notify the Engineer in writing 7 days in advance. A representative of the Engineering firm must be present for all cleaning and treatment. If Contractor performs work without notifying Engineer to allow a representative to be present and witness the cleaning, the procedure will not be accepted and will require re-cleaning in the presence of the Engineer.

B. All water systems shall be filled, flushed, and cleaned in strict accordance with equipment manufacturer's recommendations. Submit proposed chemical cleaning procedure to Engineer for approval prior to execution of this phase of work. Damage to equipment resulting from the use of improper cleaning and flushing methods shall be corrected at Mechanical Contractor's expense. All systems shall be chemically cleaned prior to final fill and before any testing.

C. After final cleaning and flush, water samples shall be taken and analyzed by an independent laboratory. Based on the results of this analysis, the system shall be treated with a permanent corrosion inhibitor and neutralizing agent. After treatment more samples shall be taken and analyzed. This process shall be repeated as many times as necessary until an acceptable laboratory report is received. A copy of all reports shall be delivered to the Engineers for review prior to final acceptance of system.

D. As a minimum, the following steps shall be accomplished during cleaning of the closed loop system. These steps are considered the minimum required and may be modified based on recommendations of the chemical treatment company during the submittal phase of the project.

1. All flushing shall be a bleed and feed operation. No fill and drain cleaning will be acceptable.
2. All coil connections shall be piped together to prevent water from circulating through the coils until system is completely cleaned, flushed, and final chemical treatment is added.
3. The loop system shall be initially flushed with potable water for a period of not less than 24 hours, but as long as necessary to remove all loose debris from the system.
4. The initial chemical cleaning shall be accomplished with a chemical capable of dissolving and holding in suspension mill scale, rust, oils, and other substances commonly found in piping systems. During this phase of the cleaning process the loop water temperature shall be raised and maintained at 140°F.
5. After circulating the initial chemicals for the period recommended by the chemical treatment company, the system shall be flushed with potable water to remove all chemical and debris.
6. If necessary a neutralizing agent shall be added to the system in accordance with the chemical treatment manufacturer's recommendations.
7. Steps 4, 5, & 6 shall be repeated as many times as necessary to insure complete system cleaning.
8. Immediately after all chemical cleaning is complete, the permanent water treatment shall be added. The permanent treatment shall be designed to prevent corrosion, inhibit rust, and prevent microbiological and bacterial growth in the closed loop system.
3.12 AQUATHERM PIPING, VALVES, AND FITTINGS

A. Install listed pipe materials and joining methods below in the following applications:

1. Aboveground: Polypropylene (PP-R) piping in SDR 7.4, 9, 11, or 17.6 based on the required minimum pressure rating and use temperature, in accordance with manufacturer’s instructions and ASTM F2389.

B. FUSION WELDING OF JOINTS

1. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer’s specifications and product standards.
2. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
3. Prior to joining, the pipe and fittings shall be prepared in accordance with F 2389 and the manufacturer’s specifications.
4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

C. VALVE APPLICATIONS

1. Install gate valves close to main on each branch and riser serving 2 or more equipment connections and where indicated.
2. Install gate or ball valves on inlet to each equipment item and elsewhere as indicated.
3. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain hydronic piping system.
4. Install swing check valve on discharge side of each pump and elsewhere as indicated.
5. Install ball valves in each hot-water circulating loop and discharge side of each pump.

D. PIPING INSTALLATIONS

1. Install hangers and supports at intervals specified in the applicable Plumbing or Mechanical Code and as recommended by pipe manufacturer.
2. Support vertical piping at each floor and as specified in the applicable Plumbing or Mechanical Code.
3. Fire stopping shall be provided to both be compatible with the Aquatherm Piping and meet the requirements of ASTM E 814 or ULCS115, “Fire Tests of Through-Penetration Firestops”. Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.
4. When installed in systems with pumps in excess of 7.5 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185°F.
5. If heat tracing is specified for the piping, it should be installed on the pipe interior or exterior, and it must be suitable for use with plastic piping and self-regulating to ensure the surface temperature of the pipe and fittings will not exceed 70°C (158°F).
3.13 INSULATION

A. Insulate all piping as specified in Section 230700 of these specifications.

END OF SECTION 230503
SECTION 230523 - VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this section includes furnishing and installing all valves for the project. Provisions of this section apply to all mechanical specifications sections.

1.2 GENERAL REQUIREMENTS

A. Isolation valves shall be installed in the inlet and outlet connection to each chiller, chilled water coil, pump, and at all other equipment. All valves used for isolation service shall be ball valve or butterfly valves unless specifically noted otherwise.

B. All valves shall be suitable for the service for which they are installed and shall be fitted with proper seats, discs, packing, lubricants, etc. All gate, globe and angle valves shall have back seats for repacking under pressure. All valves shall be installed with the stem horizontal or above. Each valve shall be individually pressure tested on shell and seat. All valves shall be designed for not less than 150 psig service minimum.

C. Valves shall be Jenkins as specified hereinafter. Suppliers of comparable products are Bray, Crane, Kennedy, Walworth, Lunkenheimer, Milwaukee, Powell, Stockham, Nibco, and Hammond unless otherwise indicated.

D. Valves for mechanical systems shall be of the same manufacturer except specialty items.

PART 2 - PRODUCTS

2.1 VALVES FOR WATER SERVICE (HVAC Systems)

A. Gate Valves: (Utilized on Steam system only)

1. Valves 2" and smaller shall be screw pattern, bronze body, union bonnet, rising stem, solid wedge, 200 psi W.W.F., Jenkins Fig. 47-U.
2. Valves 2-1/2" and larger shall be flange pattern, iron body, O.S. & Y., composition disc, renewable bronze seat ring, 200 psi W.W.P., Jenkins Fig. 651-A.
3. Valves, solder end of copper tubing 3" and smaller, bronze body, screw in bonnet, rising stem, solid wedge, 200 psig W.W.P. Jenkins 1242.
4. Gate Valves in water lines outside the building or underground shall be as follows and shall be installed with valve boxes.
5. Valves 2 inches and smaller shall be Jenkins No. 1240 with operating nut.
6. Valves 2-1/2 inches and larger shall be Jenkins No. 325 with 2 inch square operating nut.
7. Valves 2 inches through 3 inches may, at the Contractor's option, be Jenkins No. 1240.
VALVES

B. Globe Valves:

1. Valves 2-1/2" and larger shall be flange pattern, iron body, O.S. & Y., composition disc, renewable bronze seat ring, 200 psi W.W.P., Jenkins Fig 142 globe.
2. Valves, solder end for cooper tubing 3" and smaller, bronze body, screw in bonnet, renewable composition disc, 200 psi W.W.P., Jenkins Fig. 1200 or 1202.

C. Check Valves:

1. Valves 2" and smaller, shall be screw pattern, bronze body, 45 degree regrinding swing check, renewable seat, 200 psi W.W.P., Jenkins Fig 92-A.
2. Valves 2-1/2" and larger shall be flange pattern, iron body, bronze trim, regrind-renew disc and seat ring, 200 psi, W.W.P., Jenkins Fig. 624.
3. Valves, solder end for copper tubing 3" and smaller, bronze body, 45 degree regrinding bronze swing disc, 200 psi, W.W.P., Jenkins Fig. 1222.

D. Hose End Valves:

1. Valves shall be Jenkins Fig. 372 bronze gate valves with standard garden hose threads and with caps and chains or shall be gate valve with hose adaptor.

E. Butterfly Valves:

1. At the Contractor's option butterfly valves may be used for isolation service in HVAC chilled water, hot water, or condenser water lines that are 2-1/2" and larger. Butterfly valves used for isolation at items of equipment shall have lug type body, drilled and tapped, so equipment connection can be removed without removal of valve or draining of lines. Single valves used for both balancing and isolation generally will not be allowed. Butterfly valves shall not be installed so close to other equipment that the wide-open disc will touch any part of the equipment.
2. Valves shall have cast iron bodies with bronze or ductile iron disc, stainless steel shaft and lock bolts, and shaft extension to clear 2-1/2" insulation minimum. The valve shall have a reinforced resilient line, non-collapsible and blow-out proof, or Buna or other suitable material, for the temperatures to be encountered and shall give bubble tight shutoff at not less than 175 psig working pressure. The valve shall be suitable for non-shock hydrostatic pressure test of 200 psig. The valves shall have 150 lbs. flanges or shall be for mounting between 150 lbs. flanges. Valves 2-1/2 through 6" small have manual lever operators. Valves 8" and larger shall have enclosed gear operators. Valves shall be Bray series 31.

F. Silent Check Valves:

1. Silent check valves shall be installed at each water pump. The valves shall be center guided, spring loaded, non slam low pressure drop type.
2. 2" and smaller, bronze body, screwed new, bronze trim, stainless steel spring, 200 psi W.W.P., Muller Steam Specialty Co. 203 BP.
3. 2-1/2 through 10", semi steel body, wafer type, bronze trim, stainless steel spring, 125 psi W.W.P., Muller 101-AP.
4. 12" and larger, semi steel body, globe type, bronze trim, stainless steel spring, 125 psi W.W.P., Muller 105-AP.

2.2 STOP AND WASTE VALVES

A. Valves 2 inches and smaller shall be Grinnell No. E 2912 lever handle cocks, except valves in piping underground shall be E 2892 Tee handle.

2.3 BALANCING COCKS

A. Cocks 1" size and smaller shall be bronze body, screw ends, angle or straightway union pattern, Sarco "Balance Master" suitable for tight shutoff and 200 psig W.W.P. or equal ball valve with memory stop by Appollo or NIBCO.

B. Cocks 1-1/4" and larger shall be of the lubricated plug cock type, semi-steel., and suitable for a working pressure of 175 psig. the cocks shall be ACF Fig. R1430 screw pattern up through 2" size and shall be Fig. R-1431 flange pattern for sizes 2-1/2" and larger. Suppliers of comparable products are Nordstrom and Walworth.

2.4 BALANCING VALVES (Circuit Setters)

A. Balancing valves 3" and smaller shall be bronze body, screw ends, Teflon seats, stainless steel ball with precision machined orifice, and urethane packing. Valve shall be provide with a Schrader valve connection on each side of orifice for meter connection. Pressure rated 175 psi continuous duty and temperature rated 250 degrees F continuous duty.

B. Balancing valves 4" and larger shall be Semi Steel body, flange connection pattern, Teflon seats, stainless steel lubricated plug with precision machined orifice, and urethane packing. Valve shall be provide with a Schrader valve connection on each side of orifice for meter connection. Pressure rated 175 psi continuous duty and temperature rated 250 degrees F continuous duty.

C. Contractor shall provide one calibrated read out to Owner for future use with balancing valves.

D. Balancing valves shall be TACO Circuit Setter, GERAND Indicator ball valve, or approved equal.

2.5 BALL VALVES

A. Valves 2" and smaller shall be screw pattern, bronze body, 600 lb. WOG, Watts No. B-6000.

1. Valves above grade shall be provided with standard lever handle, Durafil seats, and hardened chrome plated ball. Valves on insulated lines shall be provide with valve handle extension of sufficient length to allow handle operation above outer layer of insulation.
2. Valves below grade shall be located in valve boxes and shall be provided with T-handle operator, stainless steel ball and stem, and mineral filled TFE seats and seals. Valves on insulated lines shall be provided with valve handle extension of sufficient length to allow handle operation above outer layer of insulation.

B. Valves 2-1/2" and larger shall be flanged pattern, Semi Steel body, 600 lb. WOG, Watts No. B-6000.

1. Valves above grade shall be provided with standard lever handle, Durafil seats, and hardened chrome plated ball. Valves on insulated lines shall be provided with valve handle extension of sufficient length to allow handle operation above outer layer of insulation.

2. Valves below grade shall be located in valve boxes and shall be provided with T-handle operator, stainless steel ball and stem, and mineral filled TFE seats and seals. Valves on insulated lines shall be provided with valve handle extension of sufficient length to allow handle operation above outer layer of insulation.

C. Suppliers of comparable products are Nibco, Smith, Apollo, Clayton, and Gemini.

PART 3 - EXECUTION

3.1 ALL VALVES shall be installed as recommended by valve manufacturer.

3.2 ADEQUATE PRECAUTIONS shall be taken to protect sweat or weld valves during the sweating or welding process.

3.3 GATE VALVES shall not be used for isolation service on hot water or chilled water systems only full ported ball valves shall be used on these systems. All system isolation valves shall be either full ported ball valves or positive shutoff butterfly valves depending on pipe size.

END OF SECTION 230523
PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section consists of furnishing engineering and materials necessary for vibration isolation and seismic restraints for equipment contained herein for the project.

B. All mechanical equipment 3/4 HP and over listed in the Vibration Isolation / Seismic schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure.

1. All isolation materials, flexible connectors and seismic restraints shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner at no cost to the Owner.

2. The contractor and manufacturer of the isolation and seismic equipment shall refer to the isolator and seismic restraint schedule that lists isolator types, isolator deflections and seismic restraint type. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections.

C. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipe fitting schedule. Control rods or protective braid must be used to limit elongation to 3/8”. Flexible connectors shall not be required for suspended in-line pumps.

D. Unless otherwise specified, all mechanical, and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping, and duct work in a captive position. Restraint devices shall be designed and selected to meet the seismic requirements as defined in the latest issue of the IBC or local jurisdiction building code.

1.2 SEISMIC RESTRAINT SHALL NOT BE REQUIRED FOR THE FOLLOWING

A. Hanging, wall mounted, and flexibly supported mechanical, plumbing and components that weigh 20 pounds (89 N) or less, where \( I_p = 1.0 \) and flexible connections are provided between the components and associated duct work, piping and conduit.

B. Piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches (305mm) for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolation hanger connection to structure).
C. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) designated as having an \( I_p = 1.5 \) and a nominal pipe size of 1 inch (25 mm) or less where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment. Note, any combination of piping supported on a trapeze where the total weight exceeds 10 lb/ft must be braced.

D. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) and limited deformability piping (cast iron, FRP, PVC) designated with an \( I_p = 1.0 \) and a nominal pipe size of 1 inch and less in the mechanical equipment room, or 2” and less outside the mechanical equipment room.

E. PVC or other plastic or fiberglass vent piping.

F. HVAC ducts suspended from hangers that are 12 inches (305 mm) or less in length from the top of the duct to the supporting structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2” from the top of the duct.

G. HVAC duct with an \( I_p = 1.5 \) that have a cross-section area less than 4 square feet. HVAC ducts with an \( I_p = 1.0 \) that have a cross sectional area of less than 6 square feet (0.557 m²).

H. Equipment items installed in-line with the duct system (e.g., fans, heat exchangers and humidifiers) with an operating weight less than 76 pounds (334 N). Equipment must be rigidly attached to duct at inlet and outlet.

1.3 MANUFACTURER’S RESPONSIBILITIES

A. Manufacturer of vibration and seismic control products shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.
3. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.
4. Provide calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified & stamped by an engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience and licensed in the project’s jurisdiction. Provide calculations for all floor or roof-mounted equipment, all suspended or wall mounted equipment 20lbs (89 N) or greater, and vibration isolated equipment 20lbs (89 N) or greater.
5. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer.
6. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.
1.4 QUALITY CONTROL

A. The isolators and seismic restraint systems listed herein are as manufactured by Amber / Booth, Mason Industries, Kinetics, or approved equals which meet all the requirements of the specifications, are acceptable. Manufacturer must be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

B. Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

C. All isolators, bases and seismic restraints exposed to the weather shall utilize cadmium-plated, epoxy coat or PVC coated springs and hot dipped galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

1.5 SUBMITTALS

A. Submit shop drawings of all isolators, seismic restraints and calculations provided (para 1.3).

B. The manufacturer of vibration isolation products shall submit the following data for each piece of isolated equipment: clearly identified equipment tag, quantity and size of vibration isolators and seismic restraints for each piece of rotating isolated equipment. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated deflections, and solid load. Submittals for bases shall clearly identify locations for all mountings as well as all locations for attachment points of the equipment to the mounting base. Submittals shall include seismic calculations signed and checked by a qualified licensed engineer in the employ of the manufacturer of the vibration isolators. Catalog cut sheets and installation instructions shall be included for each type of isolation mounting or seismic restraint used on equipment being isolated.

C. Provide shop drawings indicating location of all specification SC cable restraints (section 2.3.2) required for pipe and ductwork. Drawings must be stamped by manufacturer’s registered professional engineer.

D. Mechanical, electrical and plumbing equipment manufacturers shall provide certification that their equipment is capable of resisting expected seismic loads without failure. Equipment manufacturers shall provide suitable attachment points and/or instructions for attaching seismic restraints.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Specification W: A pad type mounting consisting of two layers of ribbed elastomeric pads with a ½” poro-elastic vibration absorptive material bonded between them. Pads shall be sized for approximate deflection of 0.10” to 0.18”. Pads shall be Amber / Booth Type NRC.
B. Specification A: An elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at the top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately 1/2” deflection, and incorporate a steel seismic snubber with all directional restraint. Mountings shall be Amber/Booth Type SRVD.

C. Specification B: An adjustable, freestanding, open spring mounting with combination leveling and equipment fastening bolt. The spring shall be welded to the spring mounting baseplate and compression plate for stability. The isolator shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. An elastomeric pad having a minimum thickness of 1/4” shall be bonded to the baseplate. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. This type isolator must be used with specification SL seismic restraint (section 2.3.1). Isolators shall be Amber/Booth Type SW.

D. Specification C: A unitized adjustable, stable open spring isolator with a seismic restraint housing which serves as a blocking device during equipment installation. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. The springs shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. The spring assembly shall be removable with equipment in place and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing. Isolated seismic restraint bolts shall connect top plate to lower housing to resist seismic and wind forces in all directions and limit motion to a maximum of 1/4” movement before engaging. Surfaces that engage under seismic motion shall be cushioned with a resilient elastomeric pad or grommet to protect equipment. Top plate shall have adequate means for fastening to the equipment, and baseplate shall have adequate means for bolting to structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3). Seismic isolator shall be Amber/Booth Type CTER.

E. Specification D: An elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment and an elastomeric isolation element designed for approximately 1/2” deflection. Hangers shall be Amber/Booth Type BRD.

F. Specification E: A combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, coil spring, spring retainers and elastomeric element designed for approximately 1/2” deflection. The spring shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Spring hangers shall be Amber/Booth Type BSRA.

G. Specification F: A set (two or more) of spring thrust resisting assemblies, which consist of coil springs, spring retainer, isolation washer, angle mounting brackets, and elastomeric tubing for isolating thrust resister rod from fan discharge. Thrust restraints shall be Amber / Booth Type TRK.
H. Specification SB: A unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer to protect equipment. Restraints shall allow a maximum of 1/4” movement before engaging and shall allow for the spring to be changed if required. Isolator shall be a stable spring with a minimum kx/ky of 1.0. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. Nuts and bolts shall be zinc-electroplated to prevent corrosion. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed. Baseplate shall provide means for bolting to the structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3.). Mountings shall be Amber/Booth Type SWSR.

2.2 BASES

A. Specification G: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. The steel members shall be adequately sized to prevent distortion and misalignment of the drive, and specifically, shall be sized to limit deflection of the beam on the drive side to 0.05” due to starting torque. Snubbers to prevent excessive motion on starting or stopping shall be furnished if required; however, the snubbers shall not be engaged under steady running conditions. Bases shall be Amber/Booth Type SFB.

B. Specification H: A welded WF (main member) structural steel base for increasing rigidity of equipment mounted thereon or for unitizing belt driven fans. Fan bases shall have holes drilled to match fan and located to provide required center distance between fan and supplied NEMA standard motor slide rails. The steel members shall have minimum depth of 1/12 of the longest span, but not less than 6” deep. Junior beams and junior channels shall not be used. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. Where height restrictions prevent the use of members having a depth of 1/12 of the longest span, beams of less depth may be used provided they have equal rigidity. Provide height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5” deflection or greater shall be of the precompression type to limit exposed bolt length. Bases shall be Amber/Booth Type WSB.

C. Specification J: A concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5” deflection or greater shall be of the precompression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6” deep. The base shall be sized with a minimum overlap of 4” around the base of the equipment and, in the case of belt-driven equipment, 4” beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF.
2.3 **SEISMIC RESTRAINTS**

A. Specification SL: A restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum ¼” thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4” clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test. Restraint shall be Amber/Booth Type ER.

B. Specification SC: A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to braced component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per AISI Manual for structural applications of steel cables and ASTM A630. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Amber/Booth Type LRC.

2.4 **ROOFTOP UNIT CURBS AND ISOLATION SYSTEMS**

A. Specification X: Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchor to concrete deck, or bolt or weld directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curb shall accommodate roof pitch and contractor is to verify roof pitch before ordering. Curb shall use minimun 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Seismic curbs shall be Amber/Booth Type RTC.

B. Specification Y: An extruded aluminum rail base for roof top air conditioning units consisting of top and bottom weatherproofed aluminum rails for mounting between equipment and roof curb, incorporating wind/seismic restraints and a continuous air and water seal which is protected from accidental puncture and direct sunlight by an aluminum weather shield. Rails shall incorporate free standing, open spring isolators (minimum kx/ky of 1.0) properly spaced and sized around perimeter for the deflection listed in the isolation schedule. To prevent leaks, rails shall be factory assembled (to the limits of freight carriers) and shipped as a one-piece unit. Where spliced, corners to be factory assembled. Specification X rails may only be used where wind/seismic restraint are capable of withstanding seismic forces per paragraph 1.3. Seismic design of the curb supporting the isolation rail shall be provided by the roof curb manufacturer. Rails shall be Amber/Booth Type RTIR.
C. Specification Z: Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. The upper curb shall be supported by type C isolators welded or bolted to continuous structural support which is positively anchored to concrete deck or bolted or welded to the structure to withstand seismic loading. An EPDM nylon reinforced air-tight weatherproof seal shall consolidate the upper and lower curbs. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor-supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch and contractor is to verify roof pitch before ordering. Isolation curb shall use minimum 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Isolation curbs shall be Amber/Booth Type RTIC.

2.5 FLEXIBLE PIPE CONNECTIONS

A. Specification K: Water Service: For flanged connection – a double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35 degree angular movement up to 6”, minimum 30 degree up to 12” and minimum 20 degree up to 24”. Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Amber/Booth Type 2600.

1. Water Service: For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, ¼” extension and 20 degree angular through 1-1/4”, 13 degree through 2”, and 9 degree through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to ¼”. Flex connector shall be Amber/Booth Type 2655.

B. Specification L: Steam and Condensate Service:

1. For flanged connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Amber/Booth Type SS-FP or SS-FW.

2. For threaded connections - a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Amber/Booth Type SS-PM.
C. Air Compressor Service:

1. For flanged connection – a flanged metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Connector shall be double braided with a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-FP (Special).

2. For threaded connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Connector shall be double braided and have a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-PM (special).

PART 3 - EXECUTION

3.1 Isolator and seismic restraints shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 3/4 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

A. Horizontal Pipe Isolation: all HVAC pumped water, steam, pumped condensate, glycol, and refrigerant piping size 1 1/4” and larger connected to isolated equipment shall be isolated for the first 3 support locations from externally isolated equipment with specification E hangers or specification SB or SX floor mounts with the same deflection as equipment isolators (max 2”).

B. Pipe Riser Isolation: All variable temperature vertical pipe risers 1-1/4” and larger, riser piping requiring isolation per para. 3.2.1 or where specifically shown and detailed on riser drawings shall be fully supported by specification B mounts with precompression plates. Steel spring deflection shall be .75 inch minimum except in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Pipe risers up through 16” shall be supported at intervals of every third floor of the building. Pipe risers 18” and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed. Riser supports shall be Amber/Booth Type SWP.

3.3 DUCT ISOLATION

A. Isolate all duct work with a static pressure 2” W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type E hangers or type SB (SX) floor mounts.
3.4 INSTALLATION

A. Comply with manufacturer’s instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping.

B. Locate isolation hangers as near the overhead support structure as possible.

C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of 1 inch clearance below base will result when supported equipment has been installed and loaded for operation.

E. Seismic Rated roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable. Shimming of seismic rated curbs is not allowed.

F. Housekeeping Pads shall be constructed and installed per ASHRAE’s “A Practical Guide to Seismic Restraint”. They shall be a minimum of .5” thicker than the maximum embedment required of any anchor but not less than 6”. They shall be sized to provide minimum edge distances for all installed anchors. They must be anchored to the floor structure in an approved manner.

3.5 APPLICATION OF SEISMIC RESTRAINTS

A. ISOLATED EQUIPMENT

1. All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4) in conjunction with type B isolators. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.

2. All suspended isolated equipment and vessels shall be protected with specification SC restraints. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

B. Rigidly Mounted Equipment

1. Floor mounted equipment shall be protected by properly sized anchor bolts with elastomeric grommets provided by the isolation manufacturer. Suspended equipment shall be protected with type SC bracing.
3.6 PIPING

A. All piping shall be protected in all planes by type SC restraints, designed to accommodate thermal movement as well as restrain seismic motion. (Spring-loaded control rods should be used on flexible connectors in system). Tanks and vessels connected inline to piping shall be restrained independently. Locations shall be as determined by the isolator/seismic restraint supplier and shall include, but not be limited to: (1) At a proximity to protect all drops to equipment connections. (2) At changes in direction of pipe as required to limit over stressing of pipe or movement that contacts other building material. (3) At horizontal runs of pipe, not to exceed the spacing as presented in Amber/Booth design criteria. (4) SMACNA design criteria. Seismic restraints shall not be required for piping exempted by paragraph 1.2.

B. Where riser pipes pass through cored holes, core diameters to be a maximum of 2” larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. No additional horizontal seismic bracing is required. Restrained isolators type C or SB shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints. For risers in pipe shafts, specification type SC cable restraints shall be installed at each level in a manner that does not interfere with thermal movement.

3.7 DUCTWORK

A. Duct work 6 square feet and larger in cross sectional area shall be protected in all planes by type SC restraints. Locations shall be determined by the isolator supplier and shall include, but not be limited to: (1) at equipment connections as required to protect the connections. (2) at all duct runs and duct run ends (transverse bracing and longitudinal bracing not to exceed spacing specified in Amber/Booth design criteria, or SMACNA guidelines).

END OF SECTION 230548
SECTION 230593 - BALANCING, ADJUSTING, AND TESTS

PART 1 - GENERAL

1.1 SCOPE

A. Work in this section includes the adjusting and balancing of all heating, air conditioning, and ventilating and hydronic systems. The results of all tests, adjustments, and balancing shall be submitted to the Architect for approval.

B. Provide all labor, supervision, tools, equipment, instruments, additional materials, report forms, etc. as required to complete an accurate balance of the system.

C. Belts, drives, impellers, and motors shall be adjusted and/or changed as required to obtain the required air and water quantities against the developed system pressure.

D. The refrigerant exhaust fan systems are to be balanced to provide the quantity of air as shown on drawings. System air balance is to be accompanied with certified test forms as to obtained air quantities.

E. The building water distribution system is to be balanced to provide the flow rates shown on drawings. System water balance is to be accompanied with certified test forms as to obtained air quantities. Water temperature readings across equipment shall be provided where appropriate.

F. Mechanical Contractor shall furnish competent personnel and necessary testing instruments and equipment to check, test, operate, and adjust all mechanical equipment and systems as installed. Tests shall be as required to ensure that all equipment is operating in accordance with manufacturer's recommendations, and requirements of this specification. Tests shall be of sufficient duration to prove adequacy and satisfactory performances of all items of equipment.

G. Mechanical contractor shall supply upon request without additional charge, instrumentation and personnel to spot check system balance in presence of Engineers and Owner.

H. All tests, balancing, and adjusting shall be performed as many times as required to prove project requirements have been met.

I. Control Contractor shall adjust and set all thermostats, program clock, and other control items of equipment as required. Contractor shall submit to the Architect and Engineers record copies of Control Contractor's certification that all specified control items of equipment have been installed, calibrated, and are operating properly.

1.2 QUALITY CONTROL

A. All final testing and balancing work shall be performed in complete accordance with AABC Standards for Field Measurements and Instrumentation. The Balancing work shall be performed by Carolina Air and Water Balance, Hall Technologies, Palmetto Air and Water Balance, or an Engineer-approved independent balance and test firm.
B. All work shall be under the direct supervision of a professional who is qualified for testing and balancing the hydronic and air performance of heating, air conditioning, and ventilation systems and has a minimum five years experience in the field.

C. Testing and balancing instruments shall have been calibrated within a period of six months prior to use in this work. Instruments used shall be of high quality and as recommended by AABC for the particular application.

D. Balance and Test Contractor shall attend the pre-construction meeting and shall be involved throughout the duration of the project to verify flows of chilled water to the CRI and other secondary loops as service is provided.

E. Balance and Test Contractor is to submit a proposal at the start of the project of when items that require balancing should be balanced.

1.3 SUBMITTALS

A. Before starting field work submit for approval forms, data sheets, a list of instruments and procedures.

B. Prior to acceptance of the system by the Owner, submit for approval a written report in triplicate. The reports shall be complete showing all quantities, velocities, pressure drops, and sizes.

PART 2 - PRODUCTS

2.1 Provide all materials, test equipment and instruments required for the tests.

2.2 Belts, drives, impellers and motors shall be as specified in other sections of this specification for the equipment being adjusted.

PART 3 - EXECUTION

3.1 ADJUSTMENTS

A. Thoroughly clean, flush, fill and test all systems as specifically recommended by the various equipment manufacturers and as required. Check all safety relief valves, high limit controls, freeze protection controls, and all other safety devices to determine if they are functioning properly.

B. Mechanical systems are intended to operate without objectionable noise and vibration. Make all reasonable adjustments to the installed materials and equipment to remove abnormal noise and vibration. Report, in writing, any condition that such adjustments do not correct.

3.2 TESTING AND BALANCING

A. Balance and test Contractor shall provide personnel and instrumentation to adjust, balance, record, and submit not less than two test results (including final test) for each of the following:
1. Circulating Water Pumps
   a. No Flow Differential
   b. Wide Open Differential
   c. Final Suction and Discharge
   d. Final GPM
   e. Pump Off Pressure
   f. Motor Amperage and Voltage

2. Refrigeration machines
   a. Each unit shall be checked and adjusted for maximum efficiency and proper operation in accordance with the design requirements.
   b. The following items shall be checked with the machine operating at 10%, 30%, 50%, 75%, and 100% of rated full load capacity.
      (1) Chilled water temperature, entering and leaving unit
      (2) Refrigerant condensing temperature and pressure
      (3) Refrigerant suction temperature and pressure
      (4) Outside air temperature and db and wb
      (5) Condenser water temperature entering and leaving unit
      (6) Condenser water flow rate
      (7) Amperage to the compressor motor, rated and actual operating

3. Cooling Towers
   a. Flow through each branch of supply water lines

4. Exhaust Fans
   a. Motor Amperage and Voltage
   b. Fan RPM
   c. Static Pressure
   d. Final CFM
   e. CFM at each Exhaust Grille

B. Submit record copies of all testing and balancing reports to the Architect and Engineers.

C. Test results shall be presented on approved forms. Submit three (3) copies of these reports to the Owner for approval prior to final building acceptance.

END OF SECTION 230593
SECTION 230700 - INSULATION OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Trained personnel regularly engaged in the installation of insulation and approved by the insulation manufacturer shall install the insulation in a neat and professional manner.

B. Except where specifically specified otherwise, all insulation, adhesives, coverings and coatings shall be applied in strict accordance with its respective manufacturer's recommendations.

C. No wheat paste or organic materials that breed or sustain mold shall be used in conjunction with the insulation work.

D. The Contractor shall verify that all tests and inspections of the work to be insulated have been completed and approved before the insulation is applied.

E. Adequate provisions shall be made to protect the premises, equipment, and the work of other trades against all droppings, adhesives and coatings used in the installation.

F. Pipe unions, strainers and flanges on hot lines shall not be insulated; starting and stopping points for the insulation on hot lines shall be 1 inch on either side and shall be neatly tapered and tightly sealed. Cold lines subject to sweating shall be insulated throughout, including unions, flanges and strainers.

G. Ample provisions shall be made at hanger and support points to prevent the compression of insulation beyond that recommended by the insulation manufacturer for the application.

H. All insulation shall have a composite insulation, jacket, binders, and adhesives fire and smoke hazard rating as tested by procedure ASTM E84, NFPA 255, and UL 723, not exceeding the following values and shall be so listed by UL:

   - Flame Spread 25
   - Smoke Developed 50

I. All accessories, including but not limited to, adhesives, mastics, tapes, shall have the same component ratings. All materials shall be labeled indicating compliance with the above requirements. All treatments used to obtain the required ratings shall be permanent; water-soluble treatments will not be acceptable. Flexible elastomeric insulation with smoke developed exceeding 50 is prohibited in ceiling plenums, return air plenums, or ductwork.

1.2 SUBMITTALS

A. Submit shop drawings and data to prove complete compliance with these specifications on all products and methods of installation.

1.3 SCOPE

A. Includes but not limited to insulation of the following items:
1. All chilled water and return chilled water piping inside the building along with associated valves and fittings. (Foamglas)
2. Low temperature Glycol piping systems and equipment and chilled water and hot water piping outside of building. (Foamglas)
3. Cold Equipment. (Foamglas and Armaflex)

1.4 QUALIFICATIONS

A. All insulation shall be installed in a workmanlike manner by qualified insulation mechanics. Install all insulation in strict accordance with the manufacturer's recommendations, using approved type laggings, adhesives, mastics, and other materials as applicable.

PART 2 - PRODUCTS

2.1 CHILLED WATER SYSTEM INSIDE OF BUILDINGS (chilled water piping inside of building only)

A. The mastics, adhesives, and any other product used with the insulation shall be compatible with, and approved by, the insulation manufacturer.

B. Fiberglass insulation: The insulation shall be as specified in each section. Suppliers of comparable products: Arbol, Armstrong, Benjamin-Foster, Forty-Eight Insulations, Insul-Coustics, Koppers, Owens-Corning, Vimasco, and Webers

2.2 INTERIOR CHILLED WATER PIPING, EXTERIOR CHILLED WATER PIPING

A. These specifications are based on products and data of Pittsburgh Corning Corporation and designate the type and quality of work intended under this section. Products of other manufacturers proposed as equivalent quality must be submitted for written approval by the specifying Engineer ten (10) days prior to the bid date. Supporting technical data, samples, published specifications and the like must be submitted for comparison. The contractor should warrant that proposed substitutions, if accepted, will provide performance equal to the materials specified herein.

B. FOAMGLAS insulation manufactured by Pittsburgh Corning Corporation and fabricated by a Pittsburgh Corning Corporation approved fabricator. The insulation shall comply with ASTM C552 Type II, furnished in half sections 24” long or segments 18” long.

C. Insulation Jacketing

1. Indoor Applications: All purpose jacketing or kraft paper/aluminum foil/vinyl coating construction by Lamtec Corp., Compac, Alpha Assoc., or equal.
2. Outdoor Applications: Aluminum jacketing, 0.016” thickness, with bands and seals of the same material, by Childers Products, Premetco International or equal.

D. Mastic Finish


E. Sealant

1. PITTCSEAL 444 Sealant by Pittsburgh Corning Corporation.

F. BANDING

1. Aluminum bands, 1/2" wide and 0.010" thick with matching seals.
2. Reinforced tape for insulation, 3/4" with fiber reinforcement, Scotch Brand #880, by 3M or equal.
3. Copper or stainless steel wire, 14 gauge soft-annealed.

2.3 ELECTRIC HEATING CABLE

A. Prior to installing insulation on piping, furnish and install a complete UL listed system of heaters, components, and controls to prevent pipelines from freezing. Apply heat tracing to all water piping above grade outside of building and in unconditioned rooms inside the building subject to freezing temperatures. Piping to be protected with heating cable includes but is not limited to the following pipe systems:

1. Chilled water lines
2. Make up water lines and chemical treatment lines to the cooling tower
3. Water lines to air handler humidifiers.

B. The self-regulating heater shall consist of two (2) 16 AWG nickel coated copper bus wires embedded in parallel in a self regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without over heating. The heat tracing shall be designed to be used directly on plastic pipe and shall be capable of being cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

C. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40 °F pipe temperature operation to 150 °F pipe temperature operation.

D. The heater shall operate on line voltages of 120 volts without the use of transformers.

E. The heater shall be sized according to this table. The required heater output rating is in watts per foot at 50 °F. (Heater selections based on 1" fiberglass insulation on metal piping).

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MINIMUM AMBIENT TEMP 10°F</th>
<th>MINIMUM AMBIENT TEMP -20°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch or less</td>
<td>5 watt</td>
<td>5 watt</td>
</tr>
<tr>
<td>4 inch</td>
<td>5 watt</td>
<td>8 watt</td>
</tr>
<tr>
<td>6 inch</td>
<td>8 watt</td>
<td>8 watt</td>
</tr>
<tr>
<td>12 to 14 inch</td>
<td>2 strips – 8 watt</td>
<td>2 strips – 8 watt</td>
</tr>
</tbody>
</table>
F. Power connections, end seals, splice and tee kit components shall be applied in the field.

G. The system shall be controlled by an ambient sensing thermostat (AMC-1A) set at 40 °F either directly or through an appropriate contactor.

H. Ground fault circuit breaker shall be provided as required by section 427-22 of the NEC-1987.

I. The heater shall be XL-Trace as manufactured by Raychem, Inc. Corporation or approved equal by Electromode, G.E., and Indeeco.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all insulation in strict accordance with the manufacturer's recommendations, using approved type laggings, adhesives, mastics, and other materials as applicable

3.2 ALL COLD AND HOT WATER PIPING (Inside building envelope)

A. At each hanger point on cold lines or combination cold and hot lines, a full length section of FOAMGLAS insulation with factory applied fire retardant vapor-proof jacket shall be provided to completely encompass the pipe and form a traverse vapor seal and to provide a firm point for the hanger. All surfaces of the piping and inside surfaces of the insulation and all joints in the insulation shall be coated thoroughly with I-C 405 mastic in a jacket shall be sealed with I-C 215 lap cement. End joints shall be sealed to the fiberglass insulation with factory furnished 3" wide vapor barrier self-sealing lap tape. Aluminum bands shall be provided over the edges of the joint sealer strips on not greater than 12" on center.

B. Hangers for hot water lines shall be installed around the pipe and the insulation installed around the hanger. The insulation shall be applied to the pipe with all sides and end joints firmly butted. The longitudinal joints shall be sealed with the self-sealing lap and traverse joints shall be taped with 3 inch wide pressure sensitive pre-sized glass tape.

C. Insulation shall be applied to the pipe with all sides and end joints butted firmly. Seal off ends of insulation with white vapor barrier mastic at each fitting and at 21' intervals on continuous runs. The longitudinal joints shall be sealed with the self-sealing lap strip. The traverse joints shall be sealed with factory furnished 3" wide vapor barrier type pre-size glass cloth tape, pressure sensitive.

D. Insulated pipe risers inside the building that are exposed shall be protected from the floor to 8'-0' above the floor with a .016 inch thick aluminum jacket secured with stainless steel bands. Risers in shafts and chases do not require protection.

E. Contractor may, at his opinion, use 3" wide pressure sensitive vapor barrier pre-sized glass cloth to close the longitudinal joints in lieu of the self-sealing lap.

F. Insulation shall be applied to the pipe with all sides and end joints firmly butted. The longitudinal joints shall be sealed with the self-sealing lap and the traverse joints shall be taped with factory furnished 3" wide pressure sensitive pre-sized glass cloth tape.
G. Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive or factory applied self-sealing lap.

H. Cover circumferential joints with butt strips, not less than 3-inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1 1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps.

I. Use a vapor-barrier coating or manufacturer's weatherproof coating for outside service on the ends of sections of insulation that butt against flanges, unions, valves, and fittings, and joints. Apply this vapor barrier coating at all longitudinal and circumferential laps.

J. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing and coating as specified for butt strips. Extend the patch not less than 1-1/2 inches past the break in both directions.

K. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating.

L. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 °F.

M. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior flush with the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counter flashing underneath with the vapor barrier coating.

N. Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP-58, Type 40 galvanized steel shields or MSS SP-58, Type 39 protection saddles conforming to MSS SP-69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports.

1. Insulation inserts shall be of calcium silicate, cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation.

2. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation.

3. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating for exterior work or manufacturers recommended weatherproof coating, as applicable.

5. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe.

6. Where anchors are secured to chilled piping that is to be insulated, insulate the anchors the same as the piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

O. For Flanges, Unions, Valves, Anchors, Fittings for Cold Piping, Factory-fabricated removable and reusable insulation covers may be used.
P. For piping insulation inside the building, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting.

1. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either pre-molded or segmented) around the item, butting the adjoining pipe insulation.
2. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter.
3. Use loose fill mineral wool or insulating cement to fill the voids.
4. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish coating is applied.
5. Apply two coats vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches.
6. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

Q. Insulate flexible connections at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated.

R. At the option of the Contractor, premolded, one-piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or field-fabricated insulation segments shall be used under the fitting covers. Blanket inserts may be used. Secure the covers with adhesive and vapor barrier tape with a vapor resistance of maximum 0.05 perm per ASTM E 96, or with tacks made for securing PVC covers. Then coat all tape seams and tacks with vapor barrier coating. Do not use premolded PVC fitting covers where exposed to weather.

3.3 LOOP WATER PIPING

A. All exterior piping shall be traced with electrical heat tracing for freeze protection prior to insulation.

B. Water piping exposed above grade shall be insulated with FOAMGLAS sectional pipe covering, covered with two layers of pre-sized glass cloth and waterproof mastic and finished with a 0.016" thick corrugated aluminum jacket and sealed to prevent entry of water into the insulation. Insulation shall be applied over the electric heating tape. Mastics, etc. shall be compatible with the electric heating cable. Pressure sensitive taped joints and seams will not be accepted.

C. Insulation shall be applied to the pipe with all sides and end joints butted firmly. Seal off ends of insulation with white vapor barrier mastic at each fitting and at 21' intervals on continuous runs. The longitudinal joints shall be sealed with the self-sealing lap strip then reinforced with fiberglass cloth and mastic. The traverse joints shall be sealed with factory furnished 3" wide vapor barrier type pre-size glass cloth tape and mastic. Pressure sensitive taped joints will not be accepted.

D. At each hanger point on cold lines or combination cold and hot lines, a full length section of cellular glass insulation with factory applied fire retardant vapor-proof jacket shall be provided to completely encompass the pipe and form a traverse vapor seal and to provide a firm point for the hanger. All surfaces of the piping and inside surfaces of the insulation and all joints in the insulation shall be coated thoroughly with I-C 405 mastic in a jacket shall be sealed with I-C 215 lap cement. End joints shall be sealed to the fiberglass insulation with factory furnished glass fabric tape and mastic. Where aluminum outer jackets are installed aluminum bands shall be provided over the edges of the joint sealer strips no greater than 12" on center.
E. Fittings, valves, etc. shall be covered with oversized fiberglass insulation or molded or altered fiberglass insulation of the same thickness of adjacent pipe covering, field fabricated to fit piping and wired in place with stainless steel wire, and coated with a smoothing coat of white insulating cement. After the cement is dry, apply a heavy coat of white vapor barrier mastic, apply glass fiber fitting tape overlapping the preceding lay and adjoining pipe covering 2", apply a final finishing coat of white vapor proof mastic worked into the tape and worked to a smooth finish.

F. Suitable provisions shall be made for expansion and contraction without damaging the insulation.

3.4 ALL COLD EQUIPMENT

A. Insulate all equipment not indicated elsewhere to be insulated, which shall include but not be limited to the following:

1. Chilled water pumps
2. Air separator tank on chilled water systems
3. Expansion tank on chilled water systems
4. Exposed ends of cooling coils not in a casing.

B. All equipment located in return air stream of air handling units or open to ceiling plenums shall be insulated with cellular glass blocks of not less than 2" thickness. All surfaces of the equipment and inside surfaces of the insulation shall be thoroughly coated with Insul-Coustics 405 mastic in a manner so that all voids are filled. The insulation shall be held securely in place with stainless steel wire or straps, and covered with stretched glass membrane with a tack coat of mastic. The insulation shall be finished with a coating not less than 1/2" thick of Weber's "Quik-Set" finishing cement trowelled to a smooth finish over 1 inch hexagonal wire mesh.

C. The insulation on all pumps located outside of the return air stream shall be of cellular glass, field formed into "boxes" or contoured to fit the pump. The insulation shall be sectionalized to permit easy removal of the insulation for maintenance and then re-installation. Each section shall be removable without destruction of the section removed or adjacent sections. Joints between sections shall be sealed with mastic to be vapor proof. The cement finish coating shall not be continuous over the joints. The sections shall be held together and to the pump by flange connections or by reusable stainless steel straps.

D. Equipment other than pumps, located outside of any return air stream and sealed off from any ceiling plenums: The equipment shall be insulated with 1" thick flexible, elastomeric thermal insulation applied in accordance with the manufacturer's recommendations and covered with two coats of Armaflex Finish. The insulation shall be FR/Armaflex by Armstrong.

3.5 EXTERIOR ABOVE GRADE AND BELOW GRADE CHILLED WATER PIPING

A. Preparation

1. Tests of the piping system shall be completed prior to insulation application.
2. All piping shall be cleaned of foreign substances and free of surface moisture prior to insulation application.

B. Installation above grade
1. This portion of the installation procedure is applicable only for piping located aboveground. Application of the insulation shall be as specified above.
2. Aluminum jacketing shall be applied with all laps positioned to shed water. All laps shall be a minimum of 2". Aluminum jacketing shall be secured using bands and seals as specified. Bank spacing shall be two bands equally spaced per section of insulation.
3. Fittings shall be insulated in a manner similar to that for piping.
4. For mastic finish is specified, consult Pittsburgh Corning mastic product data sheet for recommended application procedures.

C. Installation below grade

3.6 ELECTRIC HEATING CABLE

A. All piping located outside of the building conditioned envelope shall be heat traced for freeze protection prior to application of insulation.

B. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.

C. Apply "electric traced" signs to the outside of the thermal insulation.

D. After installation and before and after installing the thermal insulation, subject heat to testing using a 2500 VDC megger. Minimum insulation resistance should be 20 megohms regardless of length.

E. The installer shall test for both heating cable bus wires to verify the connection of any splices or tees.

END OF SECTION 230700
SECTION 230900 - CONTROLS

PART 1 - GENERAL

1.1 SCOPE

A. The chiller, cooling tower, chilled water pumps and tower pumps shall be compatible with the campus JCI Metasys control system. The DDC control system shall provide all information points as required by the Owner to the campus wide Johnson Control system.

B. All other control points shall be direct digital automatic temperature and energy management controls as specified below and as manufactured by Johnson Controls, or approved equal.

C. All control wiring shall conform to Electrical Section of these specifications, National Electrical Code, and unit manufacturer's recommendations.

D. New controls shall be compatible with existing Host Computer system and all points added as a part of this project shall be added to the Computer's database along with new graphic displays for all new systems and equipment. All adjustable set points and monitored points shall also be available at the Host Computer. Provide all necessary hardware and software required.

1.2 GUARANTEE

A. After completion of the installation, the Contractor shall adjust all sensors, control valves, motors and other equipment provided under this contract with trained personnel in the direct employ of the manufacturer. He shall place them in complete operating condition subject to the approval of the Owner and instruct the operating personnel in the proper use of the equipment.

B. The control system as specified herein shall be guaranteed free from defects in workmanship and materials under normal use and service for a period of one year from date of acceptance by the Owner. Any equipment proven to be defective in workmanship or materials during the guarantee period shall be adjusted, repaired, or replaced by the Controls manufacturer at no charge to the Owner.

1.3 OPERATING AND MAINTENANCE INSTRUCTIONS.

A. Three bound and indexed Operating and Maintenance Manuals shall be prepared and submitted to MUSC operating personnel. In addition, all control drawings and sequences of operation shall be provided in PDF format on CD/DVD.

B. Each manual shall contain the following information, data and drawings:

1. List of contents. Insert under front cover.
2. Copy of approved submittals, shop drawings and control diagrams.
3. Installation, operating and maintenance instructions for each item of equipment.
4. Manufacturer's list of renewal parts for each item of equipment with recommended stock items and quantities indicated.
1.4 QUALITY ASSURANCE.

A. Materials and equipment shall be the cataloged products of Controls Manufacturer.

B. Install system using competent workmen who are fully trained in the installation of proper operation of the Facilities Management and Control System.

C. Single source responsibility of supplier shall be the complete installation and proper operation of the FMCS and shall include debugging and proper calibration of each component in the entire system.

D. Factory Quality Certification:

1. The manufacturer of the Facilities Management and Control System shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). The intent of this specification requirement is to assure that the products from the Temperature Control System Manufacturer are delivered through a Quality System and Framework that will assure consistent quality in the products delivered for this project.

2. Product literature provided by the Facilities Management and Control System Manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.5 SUBMITTALS

A. Before installation of controls, submit complete submittal data, including equipment specifications, control diagrams, schematic diagrams, internal connections, and sequence of operation to the Architect for approval. Diagrams shall show all instruments, devices, tubing, etc. Set points and actions of instruments, operating ranges, and normal position of controlled devices shall be indicated. Operating sequence describing each system shall appear on the same drawing as the system's control diagram.

B. Wiring diagrams shall show conduit and wire sizes, transformers, fuses, and correct schematic diagrams for each motor starter and magnetic contactor. Diagram shall be coordinated with the equipment manufacturers involved and shall show the terminal designations for all connections to the equipment and the manufacturer's approval obtained.

C. Control submittal shall include a list of all graphic screens to be provided. Include in the submittal a flow chart of how the graphics will be interlinked. A schematic of each graphic shall be provided with all display data clearly identified.

D. Upon completion of the work, provide a complete set of drawings and application software on magnetic floppy disk media. Drawings shall be provided as AutoCAD compatible files.

PART 2 - PRODUCTS

2.1 ELECTRICAL WIRING

A. All electrical wiring, both control and interlock, shall be provided under this section of the specifications unless specifically indicated otherwise hereinafter or under the Electrical Section of the specifications.
B. Under this section of the specifications, control and interlock circuits required to enter a motor control center shall be extended to a junction box in the immediate vicinity of the motor control center. Each circuit shall be provided with a minimum of 15 feet of properly tagged wire for extension to and termination in the Motor Control center under the Electrical Section of this specification. The control manufacturer shall coordinate the wiring with the electrical equipment furnished and shall be responsible for proper terminations.

C. Unless otherwise indicated, the control power for each system shall be taken from one emergency power source to be coordinated with the owner. Provide 120 volt circuit at each panel, with a control voltage transformer, circuit breaker, and disconnect switch.

D. Refer to the Electrical Section of the specifications regarding motor starters. Only one source of power will be allowed in a starter enclosure, unless specifically noted otherwise, and relays will be used to control starter coils; however, interlock circuits may be run through auxiliary contacts of starters without additional relays unless same are required by the control functions.

E. All wiring shall be run in galvanized or sherardized rigid electrical conduit or E.M.T. where allowed under the electrical section of the specifications and shall be concealed in finished areas and occupied spaces. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation. NO PLENUM RATED CABLE WILL BE ALLOWED ON THIS PROJECT.

F. Unless specifically indicated elsewhere, all power wiring from the breaker panel to all control devices including but not limited to control panels, valves, thermostats, dampers, flow switches, control dampers, and other devices requiring power for a complete and operating system shall be provided under this Section of the work.

G. CONDUCTORS

1. 50 to 600 volts:
   a. Use solid copper, 75°C type THW, THWN or XHHW for conductors No. 10 AWG and smaller unless otherwise indicated on the drawings, required by the National Electrical Code, or specified elsewhere. Where fixtures are used as raceway use 90°C type THHN or XHHN conductors.
   b. Use No. 12 AWG stranded type THHN/THWN for control conductors on 120 volt control wiring systems unless indicated otherwise on the drawings.
   c. Splices and taps (No. 10 AWG and smaller) - Connectors for solid conductors shall be solderless, screw-on, spring pressure cabled type, 600 volt, 105 degrees C with integral insulation and UL approved for aluminum and copper conductors. Use crimp-on type connectors with integral insulating cover on stranded conductors.
   d. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295.
   e. Conductors between VFD’s and motors shall be VFD shielded cable.
2. Below 50 volts:
   a. Minimum size for individual conductors is AWG No. 18. Minimum conductor sizes for multiconductor cables is AWG No. 22. Low voltage conductors are allowed to be run in above ceiling space and in walls except where space if defined as a plenum such as above furred ceilings. In plenums, (including mechanical rooms) conductors shall be run in raceway per NEC Article 300-22 or shall be covered with Teflon FEP insulation approved for plenum applications. All other wiring (e.g., wiring run outside or exposed) shall be run in conduit.
   b. Taps and Joints: Mechanically and electrically sound.
   c. Color Code: All low voltage control conductors shall be color coded by factory.
   d. Conductor Insulation: "TFFN", unless noted otherwise.
   e. Manufacturers: Some approved manufacturers are Anaconda, Belden, Brand Rex, Continental, General Cable, Phelps Dodge, Simplex and Triangle.

H. CONTROL VOLTAGE

1. 120 volt or less control is required and may be accomplished either by individual control transformers or use of internal panel transformer where available. Control power shall come from one emergency power source. Where panel transformers are utilized, circuits shall be increased as necessary. In either, fuses shall be provided in each ungrounded primary leg.

2.2 CONTROL DEVICES AND ACCESSORIES

A. Positive positioning devices shall be provided for all control motors and valve operators used for proportioning or sequencing control, to make available the full power of the motor in both directions.

B. Pressure switches shall be complete with mercury or otherwise totally enclosed switching action. The pressure switches shall be suitable for the service and shall be of the adjustable type with ranges as required.

2.3 CONTROL VALVES

A. Valves shall be of the modulating or two-position, three-way or two-way as required and/or indicated and shall be suitable for the pressures, temperatures, and operating conditions to be encountered. Valves 2 inches and smaller shall have bronze bodies with screwed ends, and valves 2-1/2 inches and larger shall have iron bodies with flanged ends. Modulating valves shall have renewable seats and V-port or equal percentage plug. Three-way modulation valves shall have linear inner valves. All two-way valves shall have single-seal and shall be for "dead-end" service.

B. Three-way valves for modulating use on water service shall be semi-balanced, all metal, double-seated valves.

C. All control valve larger than 2-1/2" shall be provided with pneumatic actuators, valve position feedback, and pilot positioners. Electronic valve actuators with position feedback may be used for valve 2" and smaller.
2.4 MOTOR OPERATED DAMPERS

A. Motor operated dampers shall be as specified under the "Air Distribution" Section of the specifications.

B. All actuators for motor operated control dampers shall be provided under this Section unless specifically noted otherwise.

2.5 THERMOSTATIC DEVICES

A. Thermostats, electronic remote bulb type, shall be functionally similar to room type with adjustable throttling range and shall have remote bulbs of the rigid stem or with flexible capillary tubes as required. Capillaries shall be liquid-filled compensated or other approved type. Elements installed in pipe lines shall have union connected separable wells and elements installed in duct systems shall have averaging elements with the sensing portion not less than 6 feet long, unless otherwise noted. Submaster thermostats shall have field adjustable readjustment range.

B. Thermostats, electric room type, shall be low voltage type, 2-position or modulating as required, with lock type cover, concealed temperature adjustment, less thermometer, and shall have mercury type or other totally enclosed contacts. No room thermostat shall operate on a voltage in excess of 24 volts, unless specifically noted otherwise.

C. Firestats shall be electric, or the rigid element or remote bulb type as required, but shall be manually reset. Firestats shall have a fixed setpoint, and shall be set at 125°F, unless otherwise noted. All firestats shall have 2 circuit contact blocks for 4 wires.

D. Freezestats shall be as described heretofore for remote bulb thermostats, except shall be equipped with a capillary sensing element with an active length of not less than 17 feet, 1 foot of which, at any point along the element, shall be capable of activating the control instrument. All freezestats shall have 2 circuit contact blocks for 4 wires. One contact to be used for monitoring.

E. Electronic temperature sensors shall consist of nickel wire windings which varies its resistance with temperature changes. The elements shall be precision wound to a resistance tolerance of .25% at 70°F. Insertion elements other than for air shall be wound on a rigid tube and used with immersion wells. Duct insertion elements shall be protected type. Elements used outdoors shall be encased in a waterproof conduit fitting. Elements used for room sensing shall be encased in thermostat covers matching other room thermostats.

2.6 FIELD SENSORS AND DEVICES

A. ANALOG INPUT DEVICES

Resistor Temperature Detector (RTD): RTD's shall have a range of minus 50 to plus 250°F, with a resistance tolerance of .25% at 70°F. The RTD shall be encapsulated in epoxy, series 300 stainless steel, or a copper sheath. The RTD's shall be provided in either probe mounting, averaging element, or for mounting in a separable well for liquid sensing applications.

Humidity Sensors: Humidity sensors shall be solid state with a range of 10 to 80% RH with an accuracy of plus or minus 4% at 70°F. The sensing element shall be of the non-saturating type. Provide either duct or wall mounted versions based on the application required.
Pressure to Electric Transducers: For sensing applications where a pneumatic control signal exists, provide a pressure to electric transducer that develops a 1 to 5 VDC signal in response to a 3 to 15 psi input. The transducer shall be designed for operation at 24 VDC with a maximum current draw of 4 mA maximum. The transducer shall be rated for 150 percent of the normal input pressure.

Differential Pressure Transmitters: Provide electronic static pressure transmitters for the appropriate ranges as indicated on the plans or in the specifications. The device shall provide for ranges of from 0 to .1 inches of water column up to 0 to 10 inches of water column. Accuracy at any range shall be plus or minus 2 percent full scale. Units shall be rated for ten times normal input pressure. Unit shall operate from the panel 24 Volt DC supply.

B. BINARY INPUT DEVICES

Differential Pressure Switches: Provide a differential pressure switch with single pole double throw contacts. Switch operation shall be adjustable over the operating range. The switch shall have a snap-acting Form C contact rated for the application. The switch contacts shall be rated for 5 amps at 120 volts as a minimum.

Pressure Switches: Pressure switches shall have a repetitive accuracy of plus or minus one percent of their operating range and shall withstand up to 150 percent of rated pressure. Sensors shall be diaphragm or bourdon tube. Switch operation shall have a snap-acting Form C contact rated for the application. Switch contacts shall be self-wiping contacts of platinum alloy, silver alloy, or gold plated, and shall have an adjustable differential setting.

C. OUTPUT DEVICES

Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver alloy contact material. Relay operation shall be in 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression (limiting transients to non-damaging levels). All control relays shall be of the plug-in style with a separate base. All wiring shall be terminated to the base and not the relay itself.

D. CONTROL VALVES

The control contractor shall furnish all control valves as shown on the plans and/or as specified to perform the control sequence specified. Valves shall be bronze body, screwed ends 2" and smaller, iron body flanged mounted, flanged ends 2-1/2" and larger. Nominal body rating shall not be less than 125 psi. However, the valve body and packing selected shall be designed to withstand the maximum pressure and temperature encountered in the system.

Valves shall have stainless steel stems, spring-loaded teflon packing, replaceable seats and discs. Where sequencing of valves is called for, such sequencing shall be accomplished by spring ranged adequate for the applications to avoid overlap of operation and simultaneous use of heating and cooling.
Water Valves: Furnish all modulating straight-through water valves with equal-percentage contoured throttling plugs. Furnish all three-way valves with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position. Size 3-way control valves for a pressure drop equal to the unit they serve, but not to exceed 5 psi. Size 2-way control valves for a pressure drop equal to the unit they serve, but not less than 5 psi.

Steam Valves: All modulating straight-through steam valves shall have linear characteristic for 90 percent of the closing stroke and equal percentage for the final 10 percent. For steam inlet pressure less than 10 psig, size steam control valves for a pressure drop equal to 80 to 100% of the gauge inlet steam pressure.

E. DAMPER OR VALVE OPERATORS

Damper or valve operators shall be provided for each automatic damper of valve and shall be of sufficient capacity to operate the damper of valve under all conditions, and to guarantee tight close-off of valves, as specified, against system temperatures and pressure encountered. Each operator shall be full-proportioning or two-position type as required, indicated or specified, and shall be provided with spring return for normally closed or normally open position for fire, freeze, or moisture protection on power interruption as required.

Provide operators with proper linkages and brackets for mounting and attaching to devices.

Electronic Actuators: Actuators shall be sized and adjusted to provide tight close-off as required by the sequence of operation. Actuators found not to have enough torque for positive close-off shall be replaced with actuators and accessories required to make controlled device meet its intended purpose.

F. LOCAL CONTROL PANELS

Local control panels shall be constructed of steel or extruded aluminum with hinged door and keyed lock, with baked enamel finish of manufacturer's standard color. All controlling instruments, temperature indicators, relays, switches and gauges shall be factory installed and permanently labeled and located inside or face of the panel. Unless otherwise indicated, mount control and adjusting switches, temperature indicators, and other indicating or manually operated devices on the front face of the panel with suitable engraved nameplates.

Approved AS-BUILT control diagrams shall be mounted inside of each panel.

2.7 ENERGY MANAGEMENT SYSTEM

A. An energy management system shall be provided for the building. The system shall consist of a Direct Digital Controller (DDC). The DDC unit shall perform assigned control and energy management functions as a stand-alone unit, or as the second level in a three level distributing processing energy management system.

B. Energy Management Functions:

1. Each controller shall be capable of performing the following energy management routines as a minimum.
   a. Time of day scheduling (365 day Clock)
b. Timed overrides of daily programs  
c. Start/stop time optimization  
d. Peak demand limiting  
e. Duty cycling (temperature compensated)  
f. Economizer control  
g. Enthalpy changeover  
h. Supply air reset  
i. Chilled water reset  
j. Outdoor air reset  
k. Event initiated programs  
l. Occupied/unoccupied modes  

C. Control Functions:  

1. Each controller within the Building Control System shall perform both temperature control functions and energy management routines as defined by the operator.  
2. All temperature control functions shall be executed within the DDC unit Loop control shall be executed via direct digital control algorithms. The user shall be able to customize control strategies and appropriate control loop algorithms and choose the optimum loop parameters for loop control. Control loops shall support any of the control modes:  
   a. Two-position (on-off, slow-fast, etc.)  
   b. Proportional (P)  
   c. Proportional plus integral (PI)  
   d. Proportional, integral, plus derivative (PID)  
3. It shall be possible to fully create, modify or remove control algorithms within a specific DDC unit while it is operating and performing other control functions. Each control loop shall be fully user definable in terms of:  
   a. Control mode  
   b. Gain  
   c. Control action  
   d. Sampling time  
4. In order to minimize wiring and sensor costs, provide DDC units that are able to share point information such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other DDC units.  
5. The system shall permit the generation of job-specific control strategies that can be activated in any of the following ways:  
   a. Continuously  
   b. At a particular time-of-day  
   c. On a pre-defined date  
   d. When a specific measured or controlled variable reads a selected value or state.  
   e. When a piece of equipment has run for a certain period of time  

D. Battery Backup:  

1. Upon a loss of commercial power to any DDC unit, other units shall not be affected, and the loss of operation of that unit shall be reported at the designated operator's terminal. All control strategies and energy management routines defined for the DDC unit shall be retained during a power failure via the battery with the unit for a minimum of thirty (30) hours. Upon resumption of commercial power, the control unit shall resume full operation without operator intervention. The unit shall also automatically reset its clock such that
proper operation of timed sequences is possible without the need for manual reset of the clock. Controller provided with non-volatile EEPROM memory for control parameters shall be except from battery back up system.

E. User Specified Programs:

1. The library of routines available in firmware must be capable of generating programs specified by the user. These shall include but are not limited to
   a. Intermediate season control (dead Zone)
   b. Trending of variable
   c. Historical data storage
   d. Totalizing
   e. Holiday programming

F. Operator Interface:

1. The operator interface shall be capable of providing digital displays of all points addressed within the particular level two and level three controllers.
2. Each addressable hardware and software point shall be capable of being manually displayed and overridden through the operator interface.
3. In addition to local display on controller, one laptop computer for connection to system LAN and second and third level controller shall be provided as a part of this contract. Laptop computer shall include full program software with administrative level control.

G. Field Programmable:

The controller shall contain all necessary mathematic, logic, utility functions and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:

1. Math Routines:
   a. Basic Arithmetic
   b. Binary Logic
   c. Relational Logic
   d. Fixed Formulas for Psychometric Calculations
2. Utility Routines For:
   a. Process Entry and Exit
   b. Keyboard Functions
   c. Variable Adjustments and Output
   d. Alarm Indication
   e. Restart
3. Control Routines For:
   a. Signal Compensation
   b. Loop Control
   c. Energy conservation
   d. Timed Programming
4. Final field programs shall be stored in battery backed-up RAM or non-volatile EEPROM.
H. Expandability:

1. The unit shall be expandable by adding additional field interface units that operate through the processor of the controller. The processor in the DDC shall be able to manage remote field interface units thereby expanding its control loop and energy management point capacity.

I. Calibration Compensation:

1. To maintain long term analog accuracy in the controller sensing circuits, the unit shall sense the voltage being supplied to the resistance sensing element and through firmware, and compensate for power supply changes due to long term drift or drift due to ambient temperature changes at the power supply.

J. Diagnostics:

1. Each unit shall contain self diagnostics that continuously monitors the proper operation of the unit. A malfunction of the unit will be reported, and will inform the operator of the nature of the malfunction, and the control unit affected. It shall be possible to annunciate malfunctions as well as other control unit alarms at a selected central operator's terminal.

2. The system shall allow on-line diagnosis via telephone modem from a remote location (vendor's headquarters or local branch office).

K. Default Operating Procedure Alarms:

1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit. All alarms shall be displayed at the controller. A scan can then identify all alarm conditions and their identifier.

L. Adaptive Control:

1. The system shall be provided with an adaptive control setup to monitor indoor/outdoor temperatures and respond automatically to changing conditions to provide:
   a. Optimize morning start-up time to provide minimum warm-up or cool-down.
   b. Temporarily increase on-time of duty-cycled loads to correct indoor temperature variances during occupied hours.
   c. Provide night setback by automatically starting "normally off" equipment at night to keep building temperature above field adjustable low limit.
   d. Provide minimum on-time of HVAC equipment through multiple-zone control.
   e. All set points and programs shall be easily adjusted to suit individual building characteristics.

M. Demand limiting:

1. The ability to set demand control record KW setpoint level and automatically shed building loads to maintain demand setpoints shall be provided.
N. Smart Serial Interface:

1. A serial interface shall be provided to allow all data and programming information to be either uploaded or downloaded from a remote location.

O. Cabinet:

1. The controller shall be enclosed in a metal cabinet. The cabinet shall be constructed such that it can be mounted and electrical terminations made during the construction phase of the project.
2. The unit cabinet shall be provided with a key lock. All cabinets on each installation shall utilize one master key.

2.8 MONITOR AND ALARMS

A. Monitor and alarm the following points when "off normal" conditions exist. An alarm shall cause an audible alarm and display at the remote personal computer furnished by Owner.

1. Entering and leaving chilled water temperature at each chiller. "No flow" conditions on each chilled water pump scheduled to be operating. Prove with pressure differential switch sensing discharge and suction pump pressure.
2. Refrigeration machine alarm sensing the "dry" contacts furnished with the machine.
3. Pump status of each pump.
4. Fault condition at each variable frequency drive.
5. Each Chiller's entering and leaving condenser water temperatures.
6. Status of each cooling tower fan.
7. Cooling tower water level alarm.
8. Primary chilled water flow rate.
9. Temperature drift in any temperature controlled device.
10. Entering temperature for each coil.
11. Leaving temperature for each coil.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

A. Install all room thermostats and fan switches 5' AFF unless otherwise specified on plans. All room thermostats shall be furnished by unit manufacturer and wired in accordance with equipment manufacturer's recommendations for proper unit control. All control wiring shall conform to Electrical Section of these specifications, National Electrical Code, and unit manufacturer's recommendations.

B. Space instruments shall have concealed adjustments and shall be provided with tamper-proof metallic cover.

C. All controls mounted outside building shall have weatherproof enclosures.
D. Control Panels shall be located in mechanical rooms and shall be installed 5' AFF and shall be anodized aluminum or steel with baked enamel finish and designed for wall mounting. All devices on panel cover and inside panel shall be identified by plastic nameplates. Provide hinged locking door for access to devices inside panel. All enclosures and cabinets housing electrical apparatus and the secondary side of all transformers shall be grounded.

3.2 WIRING

A. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation.

3.3 RECORD DRAWING

A. A copy of the complete reviewed control diagram shall be framed under glass in each Mechanical Equipment Room. Copies shall be black line photostat.

3.4 IDENTIFICATION

A. Engraved plastic nameplates shall be provided for all control equipment. Lettering shall not be less than one-quarter inch high. Attach to fixed surface adjacent to each instrument. Label all devices on monitoring panel and room instruments. Label shall indicate device's operating range, normal setting (or reading), and function of device.

PART 4 - OPERATING SEQUENCES

4.1 CHILLED WATER SYSTEM

A. Chiller loading to maintain active chilled water set point shall be provided by the Chiller Manufacturer's unit mounted electronic controller (UCP). The existing JCI chiller plant control system will interface with this panel by providing a request for chiller operation via dry contact closure or direct protocol command whenever low temperature chilled water is required for building cooling operation.

C. The chiller plant control system will also provide a chilled water set point signal to the UCP. This setting adjustment shall be through either a 4-20ma signal or by direct protocol command.

D. Chiller sequencing:

1. The chiller plant control system shall send the chiller UCP an enable signal indicating a need for chilled water.
2. The chiller plant control system shall open the evaporator isolation valve on the chiller and start the chilled water pump. This will satisfy the chilled water flow switch for the chiller.
3. The chiller UCP shall then open the chiller condenser water isolation valve and start the condenser water pump.
4. The chiller will then go through the remainder of its internal start sequence, and if sufficient load is present, will start. The chiller will sense and control leaving chilled water temperature with its own control system. Chilled water setting will be determined by the campus-wide control system.
E.  Chiller system shall be shut down and both an audible and visual alarm issued at the operator's console indicated chiller system shutdown when any of the following conditions exist.

1.  Return chilled water temperature rises above 55 °F.
2.  Supply chilled water temperature drops below 39 °F.
3.  Cooling tower basin temperature drops below 40 °F.

4.2 CHILLED WATER SETTINGS

A.  The building control system shall determine required system chilled water setting based on air handling unit operating load. System chilled water supply temperature shall be measured by a temperature sensor downstream of the common chiller supply header.

1.  The building control system shall use a temperature reset program to adjust the building chilled water setting from a high limit of 48 °F to a low limit of 40 °F.

2.  The reset program shall be based on building chilled water demand and on building chilled water supply and return temperature differential (SRTD). As the SRTD drops below 8 °F the building chilled water supply temperature shall be reset up in direct proportion to the decrease in SRTD. The building control system shall also monitor the discharge air temperature setting at each air handling unit and the position of the chilled water valve at each air handling unit. The SRTD reset program shall be overridden by the building control system to further increase chilled water supply temperature until one of the air handling unit's chilled water valves is more than 90% open and discharge air temperature is within 1 °F of its current setting. The building control system shall override SRTD reset program to reduce chilled water temperature setting if any air handling unit's chilled water valve is 100% open and the discharge air temperature is more than 1 °F above its current setting.

B.  The chiller plant control system shall adjust the active chilled water setting for the chiller from a minimum of 40 °F to a maximum of 48 °F as required to maintain the current building chilled water supply temperature.

4.3 CHILLED WATER PUMP

A.  Each chilled water pump shall be controlled by a Variable Frequency Drive with a Hand-Off-Auto switch on the starter cover. One chilled water pump is for stand-by service. The campus-wide control system shall alternate lead/lag relationship based on run time. Lead/lag configuration shall be alternated on a weekly basis. When the VFD switch is in the "Hand" position, the Pump shall operate continuously and control speed based on local drive set point. When the switches are in the "Auto" position, the campus-wide control system shall start and stop the pump when mechanical refrigeration is required and shall modulate pump speed based on remote chilled water loop differential pressure sensor. The chilled water loop differential pressure set point shall be equal to the current active set point but shall be field adjustable to accommodate system needs as determined by the Owner. Should all air handling units be deactivated during "Off Hours" or during economizer operation, the pump shall stop. When the chilled water pump is operating, the controls to the refrigeration machines shall be activated and shall function as specified under chilled water system.

B.  The pumps shall stop under the following emergency conditions and report a critical alarm to the central operator's console:
1. Return chilled water temperature exceeds 65 °F.

C. If a pump failure is indicated by the pump status differential pressure switch, the current backup pump shall be started and the failed pump shall be stopped. An alarm shall be issued at the operator's console.

D. The building control system shall monitor air handling unit coil temperatures when chilled water pumps are off. If any of the air handling unit's low temperature devices indicates a potential freeze condition, the chilled water pumps shall be energized to prevent coil freeze up. Both an audible and visual critical alarm shall be issued at central operator's console with a message indicating a freeze condition exists and immediate action is required.

4.4 CONDENSER WATER PUMP

A. Each condenser water pump shall be started and stopped by a "Hand-Off-Auto" switch on the starter cover. When the starter is in the "Hand" position, the pump shall run continuously. When the starter is in the "Auto" position, the pump shall cycle on and off by the chiller plant control system as required to start a refrigeration machine. One condenser water pump is for stand-by service.

B. If a pump failure is indicated by the pump status differential pressure switch, the current “Stand-by” pump shall be started and the failed pump shall be stopped. An alarm shall be issued at the operator's console.

4.5 COOLING TOWERS

A. Cooling tower fans shall be interlocked with condenser water pump to prevent fan operation when condenser water pump is off. Upon activation of condenser water pump the tower isolation valve on the supply and return shall modulate open.

B. The cooling tower fan shall be controlled by a "on-off-auto" switch on the fan VFD. When a manual speed is selected, the fan shall operate continuously at that speed. When the switch is in the auto position, the tower capacity modulation system shall select the fan speed and stop and start the fan motors.

C. The tower capacity modulation system shall be activated at any time a condenser water pump operates and shall deactivate the tower fan when the condenser water pump stops.

D. A remote bulb temperature sensor located in common condenser water supply header sensing leaving tower water temperature shall control the tower by-pass valve to provide stable chiller start-up and operation. Minimum condenser water set point shall be determined by chiller control algorithm based on chiller load and outside air wet bulb temperature. The condenser water set point shall be set to 78 degrees F (adjustable). If all fans are de-activated and condenser water temperature drops below active set point the condenser water by-pass valve shall modulate open to maintain condenser water temperature above active minimum set point. On a rise in condenser water temperature the by-pass valve shall close and the condenser water DDC loop shall stage tower fans and modulate fan speeds to maintain active condenser water set point. The tower fans shall always start at the lowest speed and then stage up if required to meet condenser water control point. The cooling tower fan controls shall be interlocked with by-pass valve position. Fans shall not operate if by-pass valve is not 100% closed to the by-pass position.
E. Building EMS shall monitor and compare the condenser water temperature sensors in the tower basin and downstream of the condenser water by-pass valve. If the control system indicates the by-pass valve is fully closed and sump temperature is more than 5 °F lower than the temperature downstream of the by-pass valve, an audible and visual alarm shall be issued at the operator's console. This alarm shall indicate a by-pass valve failure. Operator acknowledgement is required to clear this alarm. Tower fan operation shall be locked out and all condenser water pumps shall be shut down by the control system until the by-pass valve failure has been acknowledged and the temperature sensor differentials are within normal ranges.

F. The cooling tower basin heater shall be interlocked with the condenser water pump to prevent heater operation when any of the condenser water pump is operating. Basin heater operation shall be locked out when outside air temperature is above 55°F.

G. The condenser water chemical treatment system shall be interlocked with the condenser water pump to prevent chemical pump operation when the condenser water pump is operating.

H. When tower low water level alarm is activated an alarm will be issued.

4.6 EXHAUST FAN

A. Rooftop exhaust fan EF-1 is energized upon signal from the refrigerant monitoring system.

END OF SECTION 230900
SECTION 230901 - ADJUSTABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 THE MANUFACTURER of the adjustable frequency controllers shall have a minimum of ten years of experience building similar equipment for controlling the speed of induction motors.

PART 2 - PRODUCTS AND METHODS

2.1 MANUFACTURERS

A. Provide adjustable frequency drives as manufactured by: Danfoss, Teco/Yaskawa or ABB.

2.2 ADJUSTABLE FREQUENCY CONTROLLER

A. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

B. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.

C. The VFD shall have dual 5% impedance DC link reactors on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. All drives must have line reactors with a total impedance of 5%. Drives with 3% DC reactors must provide additional 3% AC input line reactors. If any AC line reactors are provided, then the VFD must be increased one size to compensate for the decreased performance when using an AC line reactor.

D. The VFD’s full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.

E. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available.

F. A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor’s speed and load to adjust the applied voltage to maximize energy savings.

G. The VFD must be able to produce full torque at low speed to operate direct drive fans.
H. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

I. An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

J. Galvanic isolation shall be provided between the VFD’s power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.

K. VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

L. All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

2.3 PROTECTIVE FEATURES

A. A minimum of Class 20 I2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.

B. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.

C. Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

D. Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.

E. Protect from over voltage. The VFD shall continue to operate without faulting with a momentary input voltage as high as 130% of the nominal voltage.

F. The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.

G. VFD shall include a “signal loss detection” algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.
H. VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.

I. Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.

J. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

K. In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load.

L. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

2.4 INTERFACE FEATURES

A. Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference.

B. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.

C. Display shall be programmable to communicate in multiple languages including English, Spanish and French.

D. A three-feedback PID controller to control the speed of the VFD shall be standard.

1. This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.

E. For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.

F. The VFD’s PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.

G. The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset. Drives without three additional PID controllers must provide three additional electronic controllers that match the existing or proposed control system devices. For estimating purposes, the VFD manufacturer shall provide three electronic controllers with BACnet capability for each drive supplied.
H. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

I. Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.

J. Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set “sleep” level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD’s speed is being controlled by its PID controller, it shall be possible to program a “wake-up” feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.

K. A run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output “run request” signal to indicate to the external equipment that the VFD has received a request to run.

L. VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).

M. VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

N. Standard Control and Monitoring Inputs and Outputs

1. Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
2. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.
3. Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.
   a. Each relay shall have an adjustable on delay / off delay time.
4. Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.
   a. Each shall be independently selectable to be used with either an analog voltage or current signal.
   b. The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.
   c. A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.
   d. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,
5. One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

6. It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.

7. It shall be possible to command all digital and analog output through the serial communication bus.

2.5 SERIAL COMMUNICATIONS

A. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

1. Johnson Controls Metasys N2
2. Modbus RTU
3. Siemens FLN
4. BACnet MS/TP

B. Option boards for the following protocols shall be available:

1. LonWorks Free Topology (FTP) certified to LonMark standard 3.3

C. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system. Drives without a standard USB port for computer connection must provide one EIA-485 to EIA-232 converter for every two drives installed in addition to the no-charge PC Software to allow complete setup and access to the VFD.

D. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD’s control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

2.6 ADJUSTMENTS

A. The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

B. Four independent setups shall be provided.

C. Four preset speeds per setup shall be provided for a total of 16.

D. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.
E. Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.

F. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

G. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

H. An automatic “start delay” may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

I. Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

J. Three-Contactor bypass shall be provided that allows operation of the motor via line power in the event of a failure of the VFD. Motor control selection shall be though either a VFD output contactor or a bypass contactor that are electrically interlocked to ensure that both contactors are not energized simultaneously. A third contactor, the drive input contactor, shall be supplied as standard. This allows the powering of the VFD with the motor off or operating in bypass mode for testing, programming and troubleshooting purposes.

1. The Three-Contactor bypass shall include the following interface and control features:
   a. Mode selection via a four position DRIVE/OFF/BYPASS/TEST switch.
   b. DRIVE Mode: Both the drive input and output contactors are closed and the motor is operated via VFD power.
   c. OFF mode: DRIVE input, drive output and bypass contactors are all open.
   d. Bypass mode: Bypass contactor is closed and motor is operating from line power. Both the drive input and drive output contactors are open for servicing of the VFD without power.
   e. Test mode: Bypass contactor is closed and the motor is operated from line power. The drive input contactor is closed but the drive output contactor is open. This allows for the testing and programming of the VFD while the motor is operated via line power.

2. Contactors shall operate from a 24vdc power supply that shall function off of any two legs of the AC line and shall maintain power on the loss of any one of the AC lines.
3. A Bypass pilot light is supplied to indicate that the motor is operating from line power.
4. Common start/stop command when operating in either Bypass or VFD mode.
5. Selectable Run Permissive logic shall operate in either VFD or bypass operation. When activated, any command to start the motor, in either Hand Bypass, Remote Bypass, Hand VFD or Remote VFD shall not start the motor, but instead close a relay contact that is used to initiate operation of another device, such as an outside air damper. A contact closure from this device shall confirm that it is appropriately actuated and the motor shall then start.
6. Bypass package shall include an External Safety interlock that will disable motor operation in either bypass or VFD when open.

7. Firemode bypass operation shall be standard. When activated via a contact closure, the motor shall transfer to bypass (line power) regardless of the mode selected. All calls to stop the motor shall be ignored. These include the opening of the start command, an external safety trip or the tripping of the motor overload. Firemode operation will take precedence over all other commands.

8. The bypass must include a selectable time delay of 0 to 60 seconds before the initiation of bypass operation. When transferring from VFD to bypass modes, the time delay starts after the motor has decelerated to zero speed. This delay allows the BAS to prepare for bypass operation. Bypass packages that do not include a time delay, or do not include a selectable delay period, will not be acceptable.

9. Automatic bypass shall be selectable. When active, the motor shall be transferred to line power on a VFD fault condition. The bypass time delay shall be activate prior to this transfer to line power to allow the VFD time to attempt to recover from the fault condition prior to running in bypass.

2.7 PROTECTIVE FEATURES

A. Main input disconnect shall be provided that removes power from both the bypass and VFD.

B. Main input motor rated fuses that protect the entire package.

C. VFD only fast acting input fuses shall be provided. Packages that include only main input motor rated fusing or circuit breaker are not acceptable.

D. Overload protection shall be supplied in bypass mode.

   1. This overload shall supply minimum class 20 protection as well as wide adjustable current setting for complete motor protection when operating on line power. Those overloads that are not class 20 or current selectable will not be acceptable.

   2. Overload protection shall include phase loss and phase imbalance protection.

E. Low voltage contactor operation shall be maintained to 70% of packages nominally rated voltage. This will ensure VFD operation on low voltage conditions that would otherwise be interrupted due to contactor dropout.

F. The VFD shall be able to operate the motor at a reduced load with the loss of any one of the three phases of power. Contactors shall remain closed regardless of which phase is lost. This will ensure VFD operation on single phase conditions that would otherwise be interrupted due to contactor dropout.

G. Warranty: The complete VFD shall be warranted by the manufacturer for a period of 36 months from date of start-up. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer and not a third party. A written warranty statement shall be provided with the submittals.
PART 3 - EXECUTION

3.1 START-UP SERVICE

A. The AFC manufacturer must provide Field Service by Factory Trained Service Engineer permanently located within one hundred miles of the AFC installation location. The Factory Trained Service personnel must be supported by full-time Service Engineers employed directly by the manufacturer permanently located within 200 miles of the installation location.

B. Factory Service Personnel must provide start-up services on all AFC’s including as a minimum the following:

1. Physical inspection of the drive installation and wiring.
2. Initial power-up of the equipment, including measurement of input voltages and D-C bus voltage with no output load.
3. Initial operation of the equipment, including measurement of output voltage and current under operating load.
4. Final adjustments to drive operating parameters.

C. Modified settings, adjustments, and other notes shall be provided to the customer's representative upon completion of the start-up.

END OF SECTION 230901
SECTION 232123 - CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this section includes furnishing and installing pumps for the project. Provisions of this section apply to all mechanical specification sections.

B. OTHER SECTIONS of these specifications are a part of this section. Refer to all other sections for a complete description of the work.

1.2 SUBMITTALS

A. Submit pump curves and documentation to show specifications compliance for each pump.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The pumps shall be directly driven through a flexible coupling by a ball bearing TEFC electric motor. The motors shall be rated for continuous duty and shall be of sufficient size for the pump to operate 125% of the design GPM water flow on the pump curve without the motor's exceeding its nameplate rating. Unless otherwise scheduled, motor speed shall not exceed 1750 rpm. See 230500 ELECTRICAL, for additional motor requirements. Motor shaft shall be carbon steel and of a size and design to limit shaft deflection at the stuffing box to no more than .002 inches. Motor bearing shall be grease lubricated and sized for minimum of 20,000 hours B10 life which is equivalent to 100,000 hours average bearing life. The impeller diameter shall not exceed 85% of the cut water diameter of the voltage as measured through the centerline of the shaft. Pump and impeller selections for all air conditioning and heating water pumps shall be capable of delivering not less than 125% of design GPM at a reduced head point on the impeller curve. Selections of pumps where 125% of design flow on the pump curve fall outside of the recommended pump range will not be accepted. Pumps shall also be capable of delivering rated flow at 125% of scheduled head at scheduled flow by changing impellor size only.

B. End suction pumps shall have Woods "Sure-Flex" couplings or approved equal by Dodge or Falk. Couplings shall be equipped with safety guards. All components of the pumps, including the motors and couplings, shall be especially selected to assure quiet operation, free of excessive vibration in the opinion of the Architect. Pumps and motors shall be mounted on a common cast iron or steel bed plate. Pumps in variable speed applications shall be provided with a flexible coupling rated for variable speed/variable torque applications over full range of pump operation. The pumps shall be Taco, Bell & Gossett, Peerless, Aurora and Armstrong.

C. All pumps shall be suitable for the service for which they are installed. Special attention shall be given to suction pressure, discharge pressure and NPSH of the system where installed.
D. Vertically arranged end suction pumps shall be furnished with cast iron pump base. End suction pumps shall have suction elbow cast with the base; the base shall support the pump and the pump shall support the motor. Adequate means of maintaining motor shaft, coupling, and pump shaft alignment shall be provided by keys, rabbet fitting or motor to mounting bracket, or other approved methods. All bearings of vertically arranged pumps and motors shall be designed for the vertical loads imposed by the arrangement.

E. Provide flexible connections on both sides of all pumps. Victaulic type flexible connections are not allowed.

F. Provide service and maintenance clearances around all pumps to allow for complete disassembly of pumps.

2.2 END SUCTION PUMPS

A. The pumps shall be of the base mounted type, end suction centrifugal pumps, with cast iron body, bronze impeller, corrosion resistant steel shaft, bronze or stainless steel shaft sleeves, mechanical seals and grease lubricated ball bearings. The pumps shall be constructed for a working pressure of not less than 150 psig on the discharge side of the pump and not less than 100 psig on the suction side of the pump. If pumps are designed for very high efficiencies depending upon very close tolerances between impeller and casing, bronze wearing rings shall be provided on both casing and impeller.

2.3 INLINE PUMPS

A. The pumps shall be in-line type circulators, iron body, bronze trimmed, with sleeves bearings and mechanical seals, suitable for a working pressure of 125 psig. The pumps shall be of the type, size, capacity, etc. as indicated on the drawings, as manufactured by Taco, Peerless, Armstrong, Aurora or Bell & Gossett.

2.4 ENERGY EFFICIENT A-C INDUCTION MOTOR

A. The induction motor shall be an "energy-efficient" type and shall conform to the latest applicable standards of NEMA, IEEE, ANSI, and NEC.

B. Only motors meeting or exceeding the NEMA MG1 table 12-6 efficiency standard shall be acceptable. The NEMA nominal efficiency index shall be provided on the motor nameplate in accordance with NEMA standard MG 1-12.54.2.

C. Motors shall have Class F insulation and shall be designed for continuous-duty operation on AFC power. Nameplate service factor shall be 1.15. Design "A" or design "B" motors are acceptable.

D. Motors shall have all cast-iron construction. Rolled steel or aluminum enclosures shall not be acceptable. Maximum sound pressure shall be 88 DBA at three feet from motor.

E. The motor shall be "Duty Master XE" motor, as manufactured by Reliance Electric, or approved equals.
PART 3 - EXECUTION

3.1 MANUFACTURER’S RECOMMENDATIONS
   A. All pumps shall be installed in strict accordance with the recommendations of the manufacturer.

3.2 END SUCTION PUMPS
   A. End suction pumps and motor bed plates shall be installed on a concrete pad.
   B. The piping shall be arranged so that no strain is placed on the pump.
   C. The pumps shall be placed in proper alignment and secured to the concrete pad before piping is connected.
   D. The pump installation and alignment, including grouting in of the base, shall be performed under the direct supervision of and according to the recommendations of a qualified representative of the pump manufacturer.
   E. Pumps shall be re-aligned after final setting and prior to any operation of pump.

3.3 INLINE PUMPS
   A. Inline pumps shall be installed so that the weight and forces of the piping system shall not be transmitted to the pump.

END OF SECTION 232123
SECTION 233040 - HEAT TRANSFER EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this section of the specifications shall consist of furnishing and installing all air units, water specialties and water heating systems.

B. Other sections of these specifications are a part of this Section. Refer to all sections for a complete description of the work.

1.2 SUBMITTAL

A. Shop drawings shall be submitted as specified in Division 23. Shop drawings shall include sufficient information to prove complete compliance with the contract documents. Shop drawings on all items are required.

B. Submittals on coils may be submitted as part of the air handling unit submittal.

C. Shop drawings on all packaged units shall consist of manufacturer's literature and other information required establishing contract compliance. Wiring diagrams especially prepared for this project and showing all modifications required to interlock the unit as specified shall be submitted. The sensible and total cooling and/or heating capacity of each unit when operating at the specified conditions shall be clearly indicated.

D. Submit sound power levels for all air units with fan capacity exceeding 9000 CPM or having motors in excess of 5HP. Submit data on smaller units where the 2nd, 3rd or 4th band sound power level exceeds 65 dB. Data shall include discharge, radiated and intake.

1.3 QUALITY CONTROL

A. All cooling and/or heating coils shall be ARI certified.

B. Packaged units shall be UL labeled.

C. The capacity of all packaged units shall be tested and certified by ARI or AHAM.

PART 2 - PRODUCTS

2.1 STRAINERS

A. Basket type strainers shall be cast iron body, bolted cover, closed bottom strainer basket, with flanged connections and shall be McAlear No. 528 suitable for 150 psi working pressure, or approved equal.

B. Y-type strainers shall be brass body with brass baskets, with bottom blow-off connection, for 150 psi W.W.P., and shall be McAlear "S" or "F-1" or approved equal. Strainers 2 inches and smaller shall be screw pattern; strainers 2-1/2 inches and larger shall be flange pattern.
2.2 AUTOMATIC AIR VENTS

A. Automatic air eliminator valves for use on air separators shall be high capacity float type with back flow prevention feature to prevent air from being drawn into system. 125 psig working pressure at 240 degrees F, 3/4" inlet, 1/4" orifice, 3/8" discharge connection, self-cleaning, 2 psig minimum operating pressure, cast iron body, removable cover, bronze mechanism. Amtrol, Taco, Armstrong Pumps, Sarco, Hoffman or Armstrong Trap Co.

2.3 THERMOMETERS AND THERMOWELLS

A. Thermometers shall be installed at locations indicated on the drawings and as indicated herein. Thermometers shall be installed in a manner that they may be easily read from the floor and shall be the separable socket type. Thermometer wells shall be provided for each thermometer. The thermometer wells shall be constructed of brass and shall be provided with brass plugs and chains. All wells for insulated lines shall be provided with lagging extensions. The thermometers shall be for bottom or back connections as required for each reading and shall be as follows:

1. Thermometers shall be selected with scales so that "normal" temperature is in the mid range as approved by the Architect.
2. Thermometers shall be Treice, 9" scale, cast aluminum case and brass stem. Minimum 3-1/2" stem complete with separable brass socket well.

B. Thermometers shall be placed as shown on drawing details and at the following locations:

1. Supply and return header take-offs for hot water loop.

2.4 PRESSURE GAUGES AND TAPPINGS (Water)

A. Tappings for pressure gauges shall be provided on the entering and leaving side of each pump and elsewhere as shown on the drawings or specified. Gauge tappings shall consist of a nipple welded or screwed into the piping, a gauge cock, nipple, and a brass cap. The gauge cocks shall be serviceable brass needle valves, Treice No. 735-2. Cap shall be secured at tapping with a short section of brass chain. The exact location of gauge tappings shall be approved by the Engineer before installation.

B. Pressure gauge shall be installed on the house side of the domestic water isolation valve at the main riser.

C. Pressure gauge shall be installed on the house side of the HVAC hot water supply and return lines at the main risers.
D. Gauges shall be the Bourdon tube type with a 4-1/2" white dial with black graduations and with aluminum case with glass front. The gauges shall be installed in a manner so that they may be easily read from the floor and each gauge shall be provided with a lever handle cock. Provide brass pressure snubber for each pressure gauge. Gauges shall be Trerice, unless otherwise noted:

1. Water gauges for pump suction shall be compound gauges, range 30" Hg to 100 psi, model 600C.
2. All other water gauges shall be with a range or 0 to 160 psi, model 600C.
3. Gauges for general plumbing service, model 0-100 psi 600C.
5. Provide additional gauge cocks for use with the Energy Management System at the entering and leaving side of each pump.

E. Suppliers of Comparable Products: Ashcroft, Taylor.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All Equipment shall be installed as recommended by the manufacturer. The equipment shall be cleaned, adjusted, balanced and placed into operation.

B. Water coils shall be installed as required to prevent trapping of air in the coil.

3.2 FLOW MEASURING EQUIPMENT

A. The flow metering equipment shall be installed as recommended by the manufacturer.

B. Arrange the piping systems to provide the required lengths of straight pipe before and after the measuring elements. Elbow installations are not acceptable. Accuracy of not less than 1-1/2% will be required.

END OF SECTION 233040
SECTION 236410 - REFRIGERANT MONITOR

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this section includes furnishing and installing refrigerant monitors in the mechanical equipment room in accordance with ASHRAE 15-2010. Provisions of this section apply to all mechanical specification sections.

B. OTHER SECTIONS of these specifications are a part of this section. Refer to all other sections for a complete description of the work.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide sensors as required to provide monitoring capabilities around the new chillers. New sensors shall tie into a new Bacarach 4 zone monitor system and shall provide coverage so that no chiller is more than 50 feet from a sensor.

B. The refrigerant monitor shall continuously monitor the mechanical equipment room for refrigerant concentrations between 0 and 1000 PPM. The monitor shall be mounted at eye level on the wall of the access area to the basement. The sampling stations shall be mounted 18 inches above the floor as indicated on the drawings. The monitor must be capable of drawing a minimum of 0.75 liter/minute air sample from up to 150 feet away using 1/8" ID tubing.

C. The refrigerant monitor shall operate at 100 through 240 VAC, 60 Hz, 1 phase power. The unit enclosure shall be NEMA 4 rated and include wall mounting provisions. The monitor must be capable of accepting a 4-20 ma input. The monitor must have a 0-10 vdc and a 4-20 ma analog output that is proportional to the displayed refrigerant concentration. Scaling of the outputs must be field software selectable as 0-100 or 0-1000 PPM.

D. The refrigerant monitor shall be listed by UL 2075.

E. Each refrigerant monitor shall be compound specific and shall be calibrated at the factory to monitor the specific refrigerant type with an accuracy of +\(^\pm\) 1 PPM.

F. The refrigerant monitor shall have a human interface module with a backlit, 2 line, 16 character, clear language display. The module shall be capable of being remote mounted up to 300 feet from the monitor. All setup, alarm, diagnostic, measured concentration, and calibration information shall be accessed through the display. The monitor shall display service diagnostics and be able to integrate with the building automation system.

G. The refrigerant monitor shall draw room air through an infrared photo-acoustic sensing device allowing accurate measurement of refrigerant vapors with minimum interference from other chemicals in the vicinity. All sample filters must be provided with the unit.
H. The unit must be inherently zero-stable. Periodic re-zeroing with zero air or carbon filters is not acceptable.

I. The refrigerant monitor shall have the capability of signaling alarm levels at three concentration levels, plus a unit "trouble" alarm that indicates internal problems with the instrument. A level or trouble alarm shall cause the display to flash with a diagnostic message and activate relays necessary to initiate the following events:
   a. Energize flashing lights and horns both inside the mechanical room and outside the entrance to the mechanical room.
   b. Energize all exhaust fans as herein specified to evacuate the refrigerant from the space.
   c. Signal the Building Automation System.

J. All relays are to be independent form C, SPDT type, configurable as latching or non-latching. All latched alarms must be able to be reset from a remote source via a momentary contact opening.

K. The unit shall have field installed, remote mounted, alarm packages each consisting of three flashing lights and an audible alarm mounted in one assembly. These alarm panels shall be located as shown on mechanical drawings.

L. Refrigerant alarm shall be interlocked with emergency exhaust fan to vent area when refrigerant alarm is activated. Refrigerant monitor shall be interlocked with space thermostat to override thermostat (if it is in the off position) in the event of a refrigerant leak. The refrigerant monitor shall be a Bacarach 4 zone monitoring system.

M. Each refrigerating system shall be provided with a legible permanent sign with letters not less that 0.5 inches in height, securely attached and easily accessible, indicating the following:
   1. The name and address of the installer
   2. The refrigerant number and amount of refrigerant
   3. The lubricant identity and amount, and
   4. The field test pressure applied

N. Each entrance to the refrigerating machinery room shall be provided with a legible permanent sign, securely attached and easily accessible, reading “Machinery Room – Authorized Personnel Only.” The sign shall further communicate that entry is forbidden except by those personnel trained in emergency procedures when the alarm has been activated.

O. Insure that ALL floor penetrations are sealed watertight in the chiller mechanical room.
   1. Mechanical Contractor shall be responsible for informing General Contractor of all new penetrations associated with the installation of mechanical equipment for this project and all EXISTING penetrations related to mechanical equipment in the chiller mechanical room.
   2. Electrical Contractor shall be responsible for informing General Contractor of all new penetrations associated with the installation of electrical equipment for this project and all EXISTING penetrations related to electrical equipment in the chiller mechanical room.
   3. General Contractor shall be responsible for all penetrations either existing before the project begins or created during the project. The intent is that at the end of the project ALL floor penetrations shall be sealed watertight.
PART 3 - EXECUTION

3.1 ALL REFRIGERANT MONITORS AND SYSTEM COMPONENTS including signage shall be installed in strict accordance with the recommendations of the manufacturer and the applicable versions of ASHRAE Standards 15 and 34.

3.2 MONITOR SENSORS shall be installed 18 inches above the finished floor. The sensors shall be shielded to protect against damage, but in no way as to interfere with normal operation.

3.3 Signage as shown on the drawings shall be installed at the all entrances to the mechanical room.

END OF SECTION 236410
SECTION 236416 - CENTRIFUGAL WATER CHILLER

PART 1 - GENERAL

1.1 REFERENCES


C. ASME SEC VIII - Boiler and Pressure Vessel Code.

D. ANSI/UL 465 - Central Cooling Air Conditioners.

E. ARI STANDARD 550/590-98 - Centrifugal, Helical rotary, scroll, and reciprocating water chillers.

F. ARI Standard 575-94 Sound

G. AFBMA 9 - Load Ratings and Fatigue Life of Roller Bearings.

H. ASHRAE STANDARD 34 - Number Designation and Safety Classification of Refrigerants

1.2 SUBMITTALS

A. Acceptable Refrigerants on which chiller performance is based are: HCFC-123 and HFC-134a. All proposals for chiller performance must include an ARI approved selection method for the specified refrigerants and meet ASHRAE 90.1-2004 minimum performance requirements. Verification of date and version of computer program selection or catalog is available through the Vice President, Engineering, ARI (703) 524-8800.

B. Submit drawings indicating assembled dimensions, operating weight and load distribution, and required service, tube pull, and access clearances.

C. Submit product data indicating options and specialties, electrical requirements and wiring diagrams and connections. Indicate accessories, valves, strainers, and thermostatic valves required for complete system.

D. Submit rigging, installation, and start-up procedures. Include operations and maintenance data, parts lists, and troubleshooting guide for both chiller and starter. Include location and size of field piping connections.

E. Submit load stability data with constant entering condenser water temperature down to 20 Percent Load Stability.

F. Submit product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound level per ARI 575-94 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lbs.), and amount of oil required (lbs.).
1.3 VERIFICATION OF CHILLER CAPACITY AND EFFICIENCY

A. FACTORY PERFORMANCE TEST

B. CUSTOMER WITNESSED FACTORY PERFORMANCE TEST

1. The owner or his representative shall be notified 14 days in advance to witness the factory performance test. If the owner or his representative desires to witness the performance test, all travel expenses will be the vendor’s responsibility.

2. A certified test report of all data shall be submitted to the Contracting Officer prior to completion of the project. The factory certified test report shall be signed by an officer of the manufacturer's company. Preprinted certification will not be acceptable; certification shall be in the original.

3. The equipment will be accepted if the test is conducted in conformance with ARI Standard 550/590-98 and the proposed tolerances are met.

4. If the equipment fails to perform within proposed tolerances, the manufacturer will be allowed to make necessary revisions to his equipment and retest as required. The manufacturer shall assume all expenses incurred by the owner or his representative to witness the retest.

C. Each chiller shall be factory performance tested with the proposed refrigerant under full load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified. Proper ARI certification documents for the test loop shall be made available upon request from the manufacturer for inspection.

D. The factory test instrumentation shall be per ARI Standard 550/590-98, and the calibration of all instrumentation shall be traceable to the National Institute of Standards and Technology (formerly NBS).

E. The performance test shall be run with clean tubes in accordance with ARI 550/590-98 to include the following:

1. A downward temperature adjustment per ARI 550/590-98 Section C6.3 shall be made to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.

2. An upward temperature adjustment per ARI 550/590-98 Section C6.3 shall be made to the design entering condenser water temperature to adjust from the design fouling to the clean tube condition.

3. There shall be no exceptions to conducting the performance test with clean tubes and with temperature adjustments in (1) and (2). The manufacturer shall clean tubes, if necessary, prior to test to obtain a test fouling factor of .0000 hr. sq. ft. F/BTU.

F. Factory Performance Test shall be conducted in accordance with ARI Standard 550/590-98 and shall meet capacity tolerances as required by ARI.

G. Stable operation at a minimum load of 25 % shall be demonstrated during the factory performance test with constant entering condenser water temperature.
1.4 SOUND DATA

A. The Centrifugal Chiller Sound Pressure Level (SPL), in decibels (dB), with a reference pressure of 20 micropascals, shall not exceed Sound Levels:

<table>
<thead>
<tr>
<th>Load %</th>
<th>Decibels (A Weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>90(dB)</td>
</tr>
<tr>
<td>50</td>
<td>90(dB)</td>
</tr>
<tr>
<td>25</td>
<td>90(dB)</td>
</tr>
</tbody>
</table>

All ratings shall be in accordance with ARI Standard 575-94.

B. To represent the chiller's loudest operating condition and uncover any sound problems, reducing the temperature of the entering condenser water and/or raising the leaving chilled water temperature is not allowed when determining the Sound Pressure Levels.

1.5 VARIABLE EVAPORATOR FLOW CAPABILITY

A. The chilled water controller of each chiller shall include variable water-flow compensation capability to allow the chiller to respond quickly to accelerating or decelerating water. The variable water-flow control algorithm shall automatically adjust the control gain so that large changes in water-flow rate can be tolerated. The variable water-flow compensation capability shall allow control of the leaving chilled water temperature to within +/- 0.5°F at a water flow rate change of 25% per minute and to within +/- 2°F at a water flow rate change of 50% per minute. This option shall include factory mounted transducers to read the differential evaporator water pressure (psid) and condenser water pressure (psid).

B. The chiller unit controller must display the following data on the chiller control panel display:

- Evaporator differential pressure (psid)
- Condenser differential pressure (psid)
- Evaporator water flow rate (GPM)
- Condenser water flow rate (GPM)
- Evaporator capacity (Tons)

1.6 REGULATORY REQUIREMENTS

A. Conform to ARI Standard 550/590-98 code for rating and testing of water chillers.


C. Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.

D. Conform to ANSI/ASHRAE STANDARD 15-2010 code for construction and operation of centrifugal chillers.

E. Unit shall bear the ARI Certification Label for Water Chillers as applicable.
1.7 HANDLING AND EQUIPMENT ROOM REQUIREMENTS

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Leave factory shipping covers in place until installation.

C. Equipment Room Requirements

1. Follow minimum standards for refrigeration systems as required by ANSI/ASHRAE Standard 15-2010 paying special attention to requirements for air monitoring, ventilation, for leak detection and insuring the safety of chiller plant operating personnel.

2. Install local exhaust at relief device discharge headers and purge units.

1.8 WARRANTY

A. Provide a complete unit parts and labor warranty (including refrigerant and VFD/starter) as indicated in warranty schedule at end of this specification section.

PART 2 - PRODUCTS

2.1 SUMMARY

A. The chiller manufacturer shall furnish centrifugal water chillers as indicated in the specifications. Deliver to the site shall be included. The units shall produce the specified tonnage per the scheduled data in accordance with ARI 550/590-98. The unit shall bear the ARI certification label as applicable.

B. Chiller shall be as manufactured by Trane, York or Carrier.

C. IBC Seismic Certification

- All chillers shall be certified for seismic applications in accordance with the 2006 International Building Code. Provide Certificate of Compliance proving compliance.

- Seismic qualification testing and structural analysis shall be conducted in accordance with and strict adherence to the standards set forth within ASCE 7 by an independent approval agency with a complete list of certified models, options, and installation methods provided in an approved detailed report. The AHUs shall be approved for seismic applications when properly installed and used as intended. The basis of the certification shall be obtained through a combination of testing of the active and energized components per AC156, and analysis of the main force resisting members of the unit. Additional calculations shall be conducted to ensure components, accessories, and options remained intact and attached to the unit under seismic load conditions.

- The certification shall be based on a maximum Design Structural Response Acceleration at Short Period (Sds) value of 1.85 g's for IBC 2006. A seismic importance factor, Ip, of 1.5 shall apply to the certification to include essential facility requirements and life safety applications for post event functionality.
Structural floors, housekeeping pads, supporting curbs, and supporting steel must be seismically designed to withstand the seismic anchor loads. Installation details such as special inspection, attachment to a curb, or attachment to a non-building structure must be outlined and approved by the Engineer of Record for the project or building. The installing contractor shall be responsible for the proper installation of the equipment and must observe the seismic installation requirements set forth by the Engineer of Record.

2.2 COMPRESSOR AND MOTOR

A. The compressor shall be centrifugal.

B. Chiller shall be able to unload to part load conditions specified with condenser water relief. Hot gas bypass shall not be allowed to maintain part load conditions.

C. Compressor assembly shall be run-tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the customer in report form for approval.

D. The hermetic motors shall be either suction or liquid refrigerant cooled. Open drives are acceptable.

E. Manufacturers with speed increasing transmissions shall not exceed 12,000 RPM compressor speeds and shall inspect the gears and all bearings as recommended by the manufacturer. A report shall be forwarded to the owner each year over the first five years to confirm completion.

F. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over speed tested at 1.25 times impeller shaft speed.

G. Warranties - The compressor(s) shall be warranted by the manufacturer for a period of five years from the date of startup. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

2.3 EVAPORATOR AND CONDENSER

A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2010 Safety Code for Mechanical Refrigeration and be provided with hinged doors. The water piping connections shall be Victaulic or flanged via a water box.

B. Evaporator and condenser tubes shall be internally enhanced. The minimum tube wall thickness shall be 0.025 inches for evaporator tubes and 0.028 inches for condenser tubes. The condenser tubes shall have no more than 16 fins per inch of tube length. Finned tubes will have phenolic or chemical conversion coating with Polyelastomer Finish Coat Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action.

C. Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer as recommended by the manufacturer to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion.
D. Supply and return head water boxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

E. Insulation will be 1” insulation and cover all low temperature surfaces to include the evaporator, water boxes, and suction elbow. Economizer is insulated with 1/2” insulation.

2.4 PURGE SYSTEM

A. The manufacturers of low pressure machines must provide a purge system.

B. The purge efficiency must meet ASHRAE Guideline 3-1996 paragraph 4.4.1.1.

C. The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Guideline 3-1996, paragraph 4.4.1.2.

D. The purge shall be constructed to NEMA 1, including:
   1. NEMA 1
   2. Waterproof conduits
   3. Sealed motor terminal box
   4. Totally Enclosed Fan Cooled (TEFC) motor

2.5 CONTROLS

A. The chiller shall be controlled by a stand-alone direct Digital Control (DDC) System. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer. Chiller controls shall have BacNet interface – MSTP compatible and interface with the Johnson Controls campus EMS system.

B. The chiller control panel shall provide control of chiller operation and monitoring of chiller modules, sensors, actuators, relays and switches and shall include controls to safely and efficiently operate the chiller. Manufacturer shall provide a minimum of 8 hours training to Owner’s personnel on the operation of the control panel. Manufacturer shall furnish all chiller control software and laptop computer with software loaded and ready for operation.

C. The control panel will be built in accordance with Society of Automotive Engineers "Standard for Electrical Equipment for Automotive Industrial Machinery, 2002 Edition" (SAE HS1738) Including:
   1. Constructed to NEMA type 1
   2. Wire duct raceway
   3. Component location drawing
D. A color, liquid crystal display (LCD) shall be unit mounted and a minimum of 12” diagonal. The display shall be fully adjustable in height and viewing angle. Animated graphical representations of chiller subsystem operation shall be used to enhance the user interface. Display shall consist of a menu driven interface with easy navigation to organized subsystem reports for compressor, evaporator, condenser, purge and motor information as well as associated diagnostics. The controller shall display all active diagnostics and a minimum of 20 historical diagnostics.

E. All control wiring and sensors for chiller controls shall be enclosed in seal-tight conduits and junction boxes and in accordance with Society of Automotive Engineers "Standard for Electrical Equipment for Automotive Industrial Machinery, 2002 Edition" (SAE HS1738).

F. Safeties - the chiller control panel shall monitor the following safeties: start and running time between compressor/motor starts, low chilled water temperature, low evaporator refrigerant temperature or pressure, high condenser refrigerant pressure, evaporator and condenser water flow status, low oil pressure, low oil temperature, high oil temperature, high motor winding temperatures, sensor faults, and proper operation of unit controls.

1. To monitor bearing temperatures, all of the compressor and motor bearings, (including high speed, low speed, and thrust bearings) shall have factory installed separate temperature sensors installed in the bearing or the oil return lines of each bearing. If any oil temperature reaches or exceeds a set value, the chiller control panel shall shut down the chiller, display the diagnostic, and activate the front panel alarm indicator.

2. The chiller control panel or starter shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:
   a. Current phase loss
   b. Current phase unbalance
   c. Current phase reversal
   d. Under/Over voltage
   e. Motor current overload
   f. Momentary power loss protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current
   g. Starter contactor fault protection
   h. Starter transition failure

G. The chiller control panel shall be capable of displaying system data in English or Metric units.

H. The chiller control panel is to be provided with a starts counter and running time counter.

I. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:

1. Entering and leaving evaporator water temperatures
2. Entering and leaving condenser water temperatures
3. Compressor Motor Winding Temperature 1, 2, 3 for Hermetic Compressors or
3A. Current Protection for Open Drive Compressors
4. Saturated evaporator and condenser refrigerant temperatures
5. Evaporator and condenser refrigerant pressure
6. Oil Temperature
7. Oil Tank pressure
8. Oil pump discharge pressure
9. Differential oil pressure
10. Compressor motor starts and running hours
11. Compressor motor current, by phase
12. Compressor motor percent RLA
13. Chilled water set point and set point source
14. Purge operating mode
15. Purge operating status
16. Time until next purge run
17. Daily pumpout - 24 hours
18. Avg daily pumpout - 7 Days
19. Chiller on - 7 Days
20. Pumpout Chiller on - 7 Days
21. Pumpout Chiller Off - 7 Days
22. Pumpout - Life
23. Refrigeration - Life
24. Purge Refrigerant Compressor Suction Temp
25. Purge Liquid Temp (Chiller Cond Sat Rfgt Temp)
26. Pumpout Time since Last Regeneration
27. Purge carbon tank temperature
28. Time at Last Regeneration
29. Pumpout Total at Last Regeneration
30. Daily Pumpout Limit/Alarm
31. Absorptive capacity
32. Carbon Regen Cycles
33. Electrical current limit set point and set point source
34. Current chiller operating mode
35. Equipment room refrigerant monitor ppm levels
36. Compressor motor voltage, by phase, KW, power factor
37. Bearing Oil Temperatures
38. Discharge Temperature (compressor)

J. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the panel will automatically indicate that the chiller is in adaptive mode and if the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

K. The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls.

L. The chiller control panel shall provide a relay output that shall energize whenever the compressor is running.

M. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.
N. The chiller control panel shall provide a relay output that shall energize whenever the chiller is operating at maximum capacity.

O. The chiller control panel shall provide a head relief request relay output to indicate that the chiller is in condenser limit mode and thereby requesting condenser water temperature relief.

P. The chiller control panel shall provide an analog output signal that shall indicate the Compressor Motor Percent RLA.

Q. The chiller control panel shall provide an analog output signal that shall indicate the condenser refrigerant pressure or condenser/evaporator differential refrigerant pressure.

R. The chiller control panel shall provide condenser limit control to include a pressure transducer and interconnecting piping and wiring. This control shall be used to avoid high condenser refrigerant pressure trip outs. The control shall take action in response to the condenser refrigerant pressure. Whenever this control is in effect, the panel will automatically indicate that the chiller is in adaptive mode and if the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

S. The chiller control panel shall be able to receive the leaving chilled water temperature set point in the form of a 4-20mA or 2-10 vdc signal from the existing building energy management system.

T. The chiller control panel shall be capable of providing short cycling protection.

U. The chiller control panel shall be able to receive the electrical current limit set point in the form of a 4-20mA or 2-10 vdc signal from the existing building energy management system.

V. The chiller control panel shall be capable of independently invoking password protection of the entire display and keypad, operator settings (e.g. chilled water set point), machine configuration settings, and service start-up settings.

W. The above specified items are required as a minimum.

2.6 STARTERS

A. VARIABLE SPEED DRIVE (VSD), UNIT MOUNTED

1. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.

2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.

3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
4. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.

5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.

6. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.

7. The VSD’s shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
   a. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
   b. The entire chiller package shall be UL/CUL listed.

8. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.

   a. The VSD design shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than or equal to 5-percent. If active filters are used to meet less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection.

10. Input shall be nominal 480 volts, three phase, 60 hertz AC power, ± 10 percent of nominal voltage.

11. Line frequency 38-60 hertz.

12. The VSD shall include the following features:
   a. All control circuit voltages are physically and electrically isolated from power circuit voltage.
   b. 150% instantaneous torque available for improved surge control.
   c. Soft start, adjustable linear acceleration, coast-to-stop.
   d. Adjustable current limiting and UL approved electronic motor overload protection.
   e. Insensitivity to incoming power phase sequence.
   f. VSD and motor protection from the following faults: - Output line-to-line short circuit protection - Line-to-ground short circuit protection - Phase loss at AFD input - Phase reversal / Imbalance - Over-voltage - Under-voltage - Over temperature

13. The following VSD status indicators shall be available to facilitate startup and maintenance: - Output speed in hertz and rpm - Input line voltage - Input line kW - Output/load amps - Average current in percent RLA - Load power factor - Fault - VSD transistor temperature

14. Service Conditions - at full output power. No external venting or heat exchangers shall be required.
   a. Operating ambient temperature 32°F-104°F (0°C-40°C).
   b. Room ambient up to 95% relative humidity.
   c. Elevation to 3300 feet (1000 meters). For every 300 feet above 3300 feet, the rated output current shall be decreased by one percent.
15. Warranties  
   a. The variable speed drive shall be warranted by the manufacturer for a period of five years from the date of startup. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

PART 3 - EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the unit(s). Additional training by the factory trained service engineer will be required to train the owner’s maintenance personnel. Chiller manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.

B. A start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

C. The manufacturer shall furnish complete submittal wiring diagrams of the centrifugal chiller(s) starter(s) and associated components like cooling towers, pumps, interlocks, etc. as applicable.

D. Manufacturer shall include shipping of chillers to the site.

3.2 WARRANTY SCHEDULE

A. The machine shall be factory warranted against defects in material and labor for a period of 15 months from the date of factory start-up or 18 months from the date of delivery, whichever occurs first.

END OF SECTION 236416
SECTION 236500 - COOLING TOWERS

PART 1 - GENERAL

1.1 FURNISH AND INSTALL factory-assembled, induced draft, crossflow cooling tower with vertical air discharge, conforming in all aspects to the specifications, schedules and as shown on the plans. The cooling towers shall be Baltimore Aircoil Company (BAC) or approved equals by Evapco or Marley. Cooling tower shall be all stainless steel construction.

1.2 THE COOLING TOWERS shall be warranted by the manufacturer to perform to the conditions as indicated on the plans and schedules. Additionally, the thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by the Cooling Technology Institute or other qualified independent third party testing agency. Manufacturers’ performance guarantees or performance bonds without CTI Certification or independent field thermal performance test shall not be accepted. The cooling towers shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

1.3 UNLESS OTHERWISE NOTED in this specification, all steel basin panels and structural members shall be constructed of heavy-gauge stainless steel.

1.4 THE COOLING TOWER MANUFACTURER shall have a Management System certified by an accredited registrar as complying with the requirements of ISO9001:2000 to ensure consistent quality of products and services. Manufacturers that are not ISO9001 Certified shall not be acceptable.

1.5 IBC SEISMIC CERTIFICATION

A. All cooling towers shall be certified for seismic applications in accordance with the 2006 International Building Code. Provide Certificate of Compliance proving compliance.

B. Seismic qualification testing and structural analysis shall be conducted in accordance with and strict adherence to the standards set forth within ASCE 7 by an independent approval agency with a complete list of certified models, options, and installation methods provided in an approved detailed report. The AHUs shall be approved for seismic applications when properly installed and used as intended. The basis of the certification shall be obtained through a combination of testing of the active and energized components per AC156, and analysis of the main force resisting members of the unit. Additional calculations shall be conducted to ensure components, accessories, and options remained intact and attached to the unit under seismic load conditions.

C. The certification shall be based on a maximum Design Structural Response Acceleration at Short Period (Sds) value of 1.85 g's for IBC 2006. A seismic importance factor, Ip, of 1.5 shall apply to the certification to include essential facility requirements and life safety applications for post event functionality.
D. Structural floors, housekeeping pads, supporting curbs, and supporting steel must be seismically designed to withstand the seismic anchor loads. Installation details such as special inspection, attachment to a curb, or attachment to a non-building structure must be outlined and approved by the Engineer of Record for the project or building. The installing contractor shall be responsible for the proper installation of the equipment and must observe the seismic installation requirements set forth by the Engineer of Record.

PART 2 - PRODUCTS

2.1 THE COOLING Tower shall be constructed with a sturdy structural frame designed to transmit all wind, seismic and mechanical loads to the equipment anchorage. The frame shall be constructed of heavy-gauge steel angles and channels.

2.2 CASING PANELS shall not provide structural support and the structural frame of the tower shall accurately transfers all loads to the equipment anchorage. Casing panels shall be constructed of stainless steel.

2.3 THE COLD WATER BASIN shall be constructed of heavy-gauge Type 304 stainless steel panels and structural members. All factory seams shall be welded to ensure watertight construction and welded seams shall be warranted against leaks for a period of five (5) years from date of startup. Stainless steel basins with bolted seams are not acceptable. Basin shall include a depressed center section with drain/clean-out connection. The basin area under the fill shall be sloped toward the depressed center section to facilitate cleaning. Standard basin accessories shall include a corrosion resistant make-up valve with large diameter plastic float for easy adjustment of the operating water level, removable anti-vortexing device to prevent air entrainment, and large area lift out strainers with perforated openings. Basins shall be furnished with equalizer connections.

2.4 THE WATER OUTLET connection shall be beveled for welding and grooved for mechanical coupling or bolt hole circle designed to accept an ASME Class 150 flat face flange. The outlet shall be provided with large-area lift out strainers with perforated openings sized smaller than the water distribution nozzles and an anti-vortexing device to prevent air entrainment. The strainer and vortex device shall be constructed of the same materials as the cold water basin to prevent dissimilar metal corrosion.

2.5 THE HOT WATER DISTRIBUTION BASINS shall be the open and gravity fed for easy cleaning, and constructed of heavy-gauge stainless steel. The basins must be accessible from outside the unit and serviceable during tower operation. Basin weirs and plastic metering orifices shall be provided to assure even distribution of the water over the fill. Lift-off distribution covers shall be constructed of heavy-gauge stainless steel and designed to withstand a 50 psf (244 kg/m2) live load or 200 pound (90.7 kg) concentrated load. Gravity flow nozzles shall be snap-in type for easy removal. Should pressurized nozzles be used, they shall utilize grommets, which ensure easy removal.

2.6 FANS shall be heavy-duty, axial flow with aluminum alloy blades selected to provide optimum cooling tower thermal performance with minimal sound levels. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum tip clearance for maximum fan efficiency. The top of the fan cylinder shall be equipped with a conical, non-sagging removable fan guard.
FANS AND SHAFTS shall be supported by heavy-duty, self-aligning, grease-packed ball bearings with moisture proof seals and integral slinger collars, designed for a minimum L₁₀ life of 80,000 hours.

THE FANS shall be driven by a one-piece, multi-groove, solid back V- type powerband with taper lock sheaves designed for 150% of the motor nameplate horsepower. The powerband shall be constructed of neoprene reinforced polyester cord and be specifically designed for cooling tower service. Fan and motor sheave shall be fabricated from corrosion-resistant materials.

FAN MOTORS shall be totally enclosed fan cooled (TEFC) and mounted outside the airstream or air over (TEAO) if in the airstream. The motor shall be furnished with special moisture protection on windings, shafts and bearings. Fan motors shall be premium efficient/inverter duty type designed per NEMA Standard MG1, Section IV Part 31. Furnish cooling tower with variable frequency drive to control fan speed for capacity modulation. See specification section 230901 for VFD requirements.

THE FANS, fan shafts, sheaves, bearings, mechanical equipment support and fan motor shall be warranted against defects in materials and workmanship for a period of five (5) years from date of startup.

THE FILL and integral drift eliminators shall be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and shall be impervious to rot, decay, fungus and biological attack. The fill shall be suitable for entering water temperatures up to and including 130°F (54.4°C). The fill shall be manufactured, tested and rated by the cooling tower manufacturer and shall be elevated above the cold water floor to facilitate cleaning. Spacing between fill sheets shall be a minimum of 3/4 inches (19.1 mm) to reduce the tendency for fouling and scaling, and to ensure proper airflow for maximum cooling capacity.

AIR INLET louvers shall be separate from the fill and removable to provide easy access for inspection of the air/water interface at the louver face. Louvers shall prevent water splash out during fan cycling and be constructed of stainless steel.

TWO HINGED access doors shall be provided for access into the plenum section.

HEAVY DUDY butterfly valves shall be provided at the hot water inlet connections. These valves shall include cast iron bodies, elastomer seat and steel operating stems. There shall be a locking handle to maintain the valve setting in any position. Wafer type field supplied spool piece is required between the inlet connection and the valve.

THE COOLING TOWER cold water basin shall be provided with electric heaters to prevent freezing in low ambient conditions. The heaters shall be selected to maintain 40°F basin water temperatures. The heaters shall be electric and shall be provided with low water cutout, contactor, and thermostat.
2.16 **THE COOLING TOWER** manufacturer shall provide an electric water level control (EWLC) system. The system shall consist of water level sensing and control units in quantities and locations as indicated on the drawings. Each water level sensing and control unit shall consist of the following: NEMA 4 enclosure with gasketed access cover; solid state controls including all necessary relays and contacts to achieve the specified sequence of operation; stainless steel water level sensing electrodes with brass holder; Schedule 40 PVC standpipe assembly with vent holes, and all necessary stainless steel mounting hardware. Provide PVC union directly below the control enclosure to facilitate the removal and access of electrodes and control enclosure. The number and position of water level sensing electrodes shall be provided to sense the following: high water level, low water level, high water alarm level, low water alarm level, and heater safety cutout.

2.17 PROVIDE a mechanical local reset vibration switch. The mechanical vibration cutout switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g’s.

2.18 AN ALUMINUM ladder (with stainless steel safety cage) shall be provided for access to the fan deck. Access door or service platforms are not acceptable. 1-1/4" stainless steel pipe handrail shall be provided around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to the requirements of OSHA applicable at the time of shipment. A stainless steel platform and aluminum ladder to grade shall be provided at all access doors to access the plenum section of the cooling tower. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.72 kg) concentrated load.

2.19 AN INTERNAL platform shall be provided in the plenum section to provide for inspection and maintenance. All working surfaces shall be able to withstand 50 psf live load or 200 pound concentrated load. Other components of the cooling tower, i.e. basin floor and fill/drift eliminators, shall not be considered an internal working surface. Cooling tower manufacturers that promote these surfaces to be used as a working platform shall provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused during routine maintenance.

2.20 **THE COOLING TOWER** shall ship from the factory with the fan motor(s) (and vibration cutout switch) wired to terminal blocks encased in a Type 304 stainless steel NEMA 3R enclosure, mounted on the outside of the tower. No casing penetrations shall be permitted in the field.

**PART 3 - EXECUTION**

3.1 **MANUFACTURER’S FIELD SERVICES**

A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Provide additional training by factory service engineer to train the owner’s maintenance personnel. Tower manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.

B. A start-up log shall be furnished by the manufacturer to document the tower start-up date and shall be signed by the owner or his authorized representative prior to commissioning the towers.
C. The manufacturer shall furnish complete submittal wiring diagrams of the cooling towers, pumps, interlocks, etc. as applicable.

D. Manufacturer shall include shipping of towers to the site.

END OF SECTION 236500
SECTION 260500 - ELECTRICAL, GENERAL

PART 1 – GENERAL

1.1 FEES

A. Fees for permits are included. Deliver permits to the Architect.

1.2 SITE VISIT

A. Prior to bidding, this Contractor shall visit the job site and shall familiarize himself with all conditions under which work is to be performed and shall include in his bid all labor, material and operations required for a complete job.

1.3 DRAWINGS AND SPECIFICATIONS

A. Drawings do not indicate all hardware and fittings. Examine all plans and specifications for the project and conditions at site and arrange work accordingly, furnishing required fittings and hardware without extra charge. If a conflict exists, the greater quantity or better quality, in the opinion of the Engineer, governs.

B. Drawings and specifications are complementary; work called for in either shall be provided as if called for by both.

1.4 CODES AND STANDARDS

A. Materials, equipment and installation shall conform to the requirements of the codes and standards (latest editions) listed below. In addition, all materials, equipment, and devices shall meet the requirements of the Underwriters' Laboratories, Inc. The label of, or listing by, the Underwriters' Laboratories, Inc. will be accepted as conforming with this requirement. In lieu of the label or listing, the Contractor may submit independent proof satisfactory to the Engineer that the materials, equipment or devices conform to the published standards, including methods of tests, of the Underwriters' Laboratories, Inc. (UL), National Electrical Code (NEC), National Electrical Safety Code, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Manufacturers Association (NEMA), Illuminating Engineering Society (IES), National Fire Protection Association (NFPA), National Electrical Contractors Association Standard Practices for Good Workmanship in Electrical Contracting (NECA 1), International Building Code (IBC) and Americans with Disabilities Act (ADA).

1.5 BASIC MATERIALS AND METHODS

A. All materials installed shall be new, clean, in good condition and shall meet applicable provisions of codes and standards listed above.

B. Workmanship shall be in accordance with best practice.
1.6 SCOPE

A. Provide all labor, equipment, material, and operations required for complete, safe and quietly-operating electrical systems in accordance with specifications and drawings and subject to terms and conditions of the contract.

B. The work includes:

1. Grounding in accordance with specifications, drawings and codes;
2. Complete distribution system for power including switchgear, switchboards, motor control centers, panelboards, safety switches, feeders, branch circuits, and connections to outlets and devices for power utilization;
3. Empty raceways, cabinets, equipment panels, and service entrance for structured cabling equipment;
4. Power supply connections to mechanical equipment;
5. Cutting and patching as required for provision of the work;
6. Fireproofing and caulking as required;
7. Seismic restraint for electrical system components;
8. Partial demolition of existing electrical system.

1.7 CUTTING AND PATCHING

A. Provide under this contract all cutting and patching of walls, floors, partitions, ceilings, etc. required for proper installation of the new system.

B. Provide patching to match the existing finish of the building. Do not cut joists, beams, girders, columns, or other structural members without written permission from Owner.

C. Ceiling tile shall be removed and reinstalled by a qualified franchised acoustical tile contractor regularly engaged in this type of work. Replace damaged tile with new tile of color and pattern to match existing tile. Submit samples for approval.

D. Relocation of existing conduit, equipment, wiring, etc. as required for installation of new system is included in this work. Perform all work in accordance with specifications for new work of the particular type involved.

1.8 ROOF PENETRATIONS

A. Contractor shall coordinate roof penetrations with other trades and shall provide all work required for complete raceways and raceway supports for electrical work for roof-mounted equipment and devices.

B. Provide flashing devices not included under other divisions of these specifications. All work shall comply with requirements for roof construction and shall in no way alter any specified roof performance or warranties.

C. Where several services (e.g., electrical and refrigeration) are connected to a single equipment, coordinate with other trades involved to minimize roof penetrations and to perform work in a workmanlike manner.
D. Lay out work in advance and locate raceway penetrations as near equipment connection points as possible. Where more than one raceway serves equipment, extend all raceways through a common flashing device with one roof penetration and leave sufficient space between raceways to affect a leakproof seal.

E. Contractor shall examine other divisions of these specifications and shall comply with all requirements for a complete project.

1.9 SEISMIC RESTRAINTS

A. Provide seismic restraint of new electrical systems and equipment as required by applicable versions of International Building Code (IBC) and ASCE 7. Seismic restraint products shall be by Mason Industries, TOLCO, Unistrut Corporation, Grinnell Corporation, Amber Booth, Peabody or approved equal.

B. Include in bid all required seismic design, performed by a registered South Carolina Professional Engineer, as required for compliance with IBC. Provide stamped and sealed calculations for all connections of equipment to structures as part of shop drawing submittals. Additionally, shop drawings shall include floor plans, sections, and elevations as required to indicate location, type connection and type of all components provided.

1.10 DAMAGES

A. Cost of repairing damage to building, building contents, and site during construction and guarantee period resulting from this work is a part of this contract.

1.11 MATERIAL AND EQUIPMENT

A. New and as specified or approved equal.

B. Where several units of one type of equipment are used, all units shall be products of the same manufacturer.

C. Any increase in the cost of this work, resulting from substitution of any product or products for those specified is part of this contract. Such work shall be accomplished in an approved manner at no extra cost to the Owner.

1.12 REQUESTS FOR PRIOR APPROVAL

A. Requests for prior approval shall comply with AIA A701-1997, Instructions to Bidders – South Carolina Division of Procurement Services, Office of State Engineer Version, Article 3.3.

B. In addition, requests for prior approval shall include the following:

1. Date of request
2. Project Name as shown on bid documents
3. Requesting Company’s Name (if not on letterhead)
4. Summary sheet for lighting fixtures with same information required on shop drawing submittals.
1.13 OPERATING INSTRUCTIONS, PANELBOARD DIRECTORIES AND NAMEPLATES

A. Instruct owner in operation of all systems.

B. Install in each panelboard a single-sided plastic-covered, typewritten circuit directory in metal frame. Indicate name, address and service telephone number of installer. Directory shall list the load served and the location of the load for each breaker.

C. Nameplates Provided by Contractor: On all panelboards, disconnect switches, transformers and enclosures, provide engraved plastic laminate nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Attach nameplates with epoxy cement or screws. On main switchboard/panelboard and feeder distribution panelboards, provide nameplate for each circuit breaker.

D. Nameplates Provided by Equipment Manufacturers: All switchboards, panelboards, transformers, safety switches and the like shall be provided with engraved metal nameplates which state all industry-standard required data about the labeled equipment. Nameplates shall be affixed with screws or rivets. The use of paper nameplates only will not be accepted.

1.14 SHOP DRAWINGS

A. The Engineer will review and take appropriate action on shop drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general compliance with the design and with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been made.

B. Prior to submittal of shop drawings to the Engineer, the General Contractor and the Electrical Subcontractor shall review and approve shop drawings. Shop drawings which have not been reviewed and approved in writing by the Electrical Subcontractor will not be reviewed by the Engineer. Electrical Subcontractor shall state in writing on shop drawings, any proposed deviations from contract documents. Such deviations, if not stated in shop drawings submittal, shall be the sole responsibility of the Electrical Subcontractor.

NOTE: IN ADDITION TO THE GENERAL CONTRACTOR'S APPROVAL AND STAMP, THE FIRST PAGE OF EACH SHOP DRAWING SUBMITTAL SHALL CONTAIN THE WORDS "APPROVED" OR "APPROVED AS NOTED," AND SHALL BE SIGNED, AND DATED BY THE ELECTRICAL SUBCONTRACTOR BEFORE THE ENGINEER WILL REVIEW THEM.

C. Lighting fixture submittal shall contain a cover sheet listing:

   1. Project name;
2. All proposed fixtures by symbol, manufacturer, and catalog number;
3. Contractor's approval stamp and signature as noted above.
4. Attach lighting fixture catalog pages (cuts) to cover sheet.

D. Electrical subcontractor shall submit for review by the Engineer detailed shop drawings of all equipment and all material listed below. All submittals shall be submitted at one time. Partial submittals will not be reviewed by the Engineer. No material or equipment for which Engineer's review is required shall be delivered to the job site or installed until this contractor has in his possession the reviewed shop drawings for the particular material or equipment. The shop drawings shall be complete as described herein. This Contractor shall furnish the number of copies specified by the Architect or six (6) copies of shop drawings if no number is specified by the Architect.

E. Shop drawings submitted for review shall be detailed, dimensioned drawings or catalog pages showing construction, size, arrangement, operating clearances, performance characteristics and capacity.

F. Samples, drawings, specifications, catalogs, submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, contractor's name, and project name.

G. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

H. Review rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. WHERE DRAWINGS ARE REVIEWED, SAID REVIEW DOES NOT MEAN THAT DRAWINGS HAVE BEEN CHECKED IN DETAIL; SAID REVIEW DOES NOT IN ANY WAY RELIEVE THIS CONTRACTOR FROM HIS RESPONSIBILITY OR NECESSITY OF FURNISHING MATERIAL OR PERFORMING WORK AS REQUIRED BY THE CONTRACT DRAWINGS AND SPECIFICATIONS.

I. Failure of contractor to submit shop drawings in time for review by Engineer with reasonable promptness consistent with sound professional practice shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.

J. The Contractor shall submit shop drawings for the following materials and equipment for review by Engineer: See "Note" in paragraph B, above.

1. Panelboards
2. Circuit breakers and trip unit
3. Safety switches
4. TVSS/SPDs
5. Seismic calculations and equipment
6. Basic materials: wire, conduit, fittings, wiring devices
1.15 RECORD DATA

A. Preserve one set of approved shop drawings and deliver to Owner prior to substantial completion of the work. Owner's shop drawings shall be bound in a 3-ring binder of good quality, with stiff vinyl or cloth front and back. Number of copies shall be as directed by Architect.

1.16 RECORD DRAWINGS

A. Contractor shall maintain on the job site one complete set of drawings for this project. All changes authorized by the Engineers and/or the Owner as to the locations, sizes, etc. of equipment, conduit, fixtures, and/or other material and equipment shall be indicated in red pencil on the drawings as the work progresses. At the completion of the project, Contractor shall obtain a complete set of reproducibles of the drawings and shall transfer all changes to these reproducibles. The number of record prints specified by the Architect shall be delivered to the Architect.

1.17 COORDINATION WITH OTHER TRADES

A. Coordinate with other trades to conceal electrical work and provide electrical work in correct locations for each piece of mechanical, or electrical equipment connected.

B. Conceal outlets for all water coolers, mechanical equipment, etc., in finished areas. Obtain roughing diagrams for all devices and install electrical work according to diagrams.

C. Locate all outlets at uniform heights to suit block coursing. Heights shown in drawings may be varied to suit coursing but shall in all cases comply with codes.

1.18 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

A. Provide complete power wiring and connections for mechanical systems specified under Division 23. This work includes all raceways, conductors, outlet and pull boxes, line voltage on-off switches where indicated and disconnecting means as indicated and required by applicable codes. Where magnetic motor starters, variable frequency drives or other controllers are furnished by others, install and wire complete; where controllers are provided already mounted on equipment, wire complete. In all cases provide power wiring through controller to load; do not reduce. Make all connections and color code per this division. Unless noted otherwise, safety switch enclosures shall be NEMA Type 3R outdoors and in wet locations; NEMA Type 1, elsewhere. Not included in this division is temperature control wiring, equipment control wiring, and interlock wiring required to operate the mechanical system, except as specified below for water heaters. Refer to Division 23 for equipment provided under that Division.

1.19 EQUIPMENT FOUNDATIONS AND MOUNTING

A. Unless otherwise noted, set all floor and ground mounted equipment on minimum 6” high concrete pads reinforced with 6 x 6, 10/10 WWM. Epoxy dowel #4 rebar 12” on center along entire perimeter of pad as required to tie pad into base slab. Pads to be approximately 6” larger than equipment base and have 1” x 1” chamfer on all edges. Pads to have carborundum brick rubbed finish. Surface finish to be uniformly smooth.
B. For generators, large transformers and other large or heavy equipment, provide foundation and equipment pads as directed by equipment vendor and to suit soil conditions.

C. For transformers, provide isolating pads between equipment and foundation or structural support. Pads shall be formed by a minimum of two layers of 1/4"-5/16" thick neoprene, ribbed or waffled on both sides. Connect circuits through flexible conduit of 24" length to prevent transmission of vibration to structure or raceway system.

D. Provide all required mounting devices, hardware, supplementary steel and other materials to mount equipment. Mountings shall be secured to structure and seismically braced to comply with codes. Where additional structural members such as columns, beams, and the like are required to mount equipment, they shall be provided at no additional cost to the Owner.

1.20 TESTS, PERFORMANCE

A. Upon completion of work, the system shall be free of faults, including short circuits, grounds and open circuits and loads shall be balanced across phases to obtain minimum neutral current in all feeders and branch circuits. Test systems as required in the presence of the Engineer or his representative and operate to comply with applicable codes and contract documents.

B. For all fire safety systems, test systems completely and exercise all user stations, initiation/activation stations and warning/output devices prior to substantial completion by the Engineer. Furnish certificate to Engineer stating that systems are complete and operational and have been operated by the Contractor as specified above.

C. All costs associated with correction of deficiencies in the work shall be borne by the Contractor. Defective material and equipment shall be replaced; do not repair.

D. All devices which must be adjusted or set to operate on a schedule (time clocks, program mechanisms, etc.) shall be set prior to substantial completion to operate on schedules directed by the Owner.

E. All adjustable breakers shall be adjusted in field to settings determined by an engineering coordination study as required to determine appropriate settings for optimal power distribution coordination. Include in bid all required work and engineering services as required for this study and adjustment.

1.21 DEMONSTRATION

A. Instruct owner in operation of all systems. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

1.22 WARRANTIES

A. The Contractor Agrees:

1. To correct defects in workmanship, materials, equipment, and operation of all systems for a period of one year from the date of Substantial Completion.

2. To remove any item not specified or given written approval and replace it with an approved item.
3. That all systems provided will safely, quietly, and efficiently operate in accordance with the design.

B. This does not supersede manufacturer’s warranties which may extend beyond one year.

1.23 CONSTRUCTION SEQUENCE

A. The Contractor is cautioned that the project may be constructed in stages to accommodate the owner's use of the building. This contractor shall verify requirements prior to bidding and shall cooperate in all respects with other contractors and trades on the job to carry out the work with minimum disruption of both the owner's requirements and construction of the project.

1.24 DETAILS

A. The details and sketches in the drawings are construction standards applicable to this project.

B. The contractor shall comply with details as applicable to the work indicated and shall retain on the job site at all times, a complete set of drawings and specifications.

1.25 DEFINITIONS

A. In this division of the specifications and accompanying drawings, the following definitions apply:

1. Provide: To purchase, pay for, transport to the job site, unpack, install and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware and operations required for completion.

2. Install: To receive from another contractor, the owner or another entity and install complete and ready for operation. Unless otherwise indicated, receipt is assumed to be at the job site.

3. Furnish: To purchase, pay for and deliver to the job site for installation by others.

4. The contractor is cautioned that “furnish” and “install” require coordination with others. Such coordination shall be accomplished prior to bidding and bid amounts shall include all required labor, material and operations for completion of all items and systems specified and indicated.

5. As Indicated: As shown in drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 260500
SECTION 260510 - ELECTRICAL, DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this Section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide all labor, material and operation required for removal of existing electrical systems as indicated.

B. Bidders shall visit the site of the work prior to bidding and shall include in bid all work required to provide new work and to modify existing work as required to continue in operation.

C. Contractor shall examine demolition and new work plans for all trades and include in bid all rework and/or relocation of existing raceway, junction boxes, panelboards, safety switches, devices, wiring systems and all other related electrical equipment as required to accommodate new construction.

D. Electrical demolition work generally includes:

1. Existing panelboards, safety switches and other electrical equipment as indicated;
2. Existing fire alarm system upon completion of new fire alarm system. Existing fire alarm system shall remain in operation until new system is fully operation, certified, and accepted by the Owner;
3. Exposed conduits, surface metal raceways and exposed outlet boxes and devices as indicated;
4. Conductors exposed and concealed as indicated;
5. Existing wiring devices as indicated. Where new wiring devices are shown in existing locations, the Contractor may re-use the existing opening and outlet box for new device;
6. Any existing abandoned wiring systems in ceiling space, crawl space, attic or similar cavities of the work areas of the building, including wire, raceways, boxes and supports as indicated;
7. Existing electrical work for mechanical equipment being removed by others;
8. Where indicated on drawings, existing raceways may be reused for new circuits. Contractor shall mandrel brush and swab existing feeder conduits prior to pulling new conductors.

E. Include in bid all work required for temporary wiring and associated electrical work required to maintain existing systems in service during demolition phase.

F. Existing ceiling systems are being removed and replaced under this contract. Include in bid all work as required for relocation of all existing ceiling mounted electrical devices (fire alarm devices, sensors, cameras, clocks, speakers, etc.) to new ceiling system. Provide removal,
protection of, temporary support and reinstallation complete.

G. All interruptions in electrical systems (power, lighting, communication, fire alarm and other systems) as required for this work shall be coordinated with and approved by Owner prior to performing work. Notice shall be provided to Owner in writing a minimum of 48 hours in advance, but not less than the time specified in other portions of Contract Documents.

H. The intent of this specification is to obtain removal of the existing electrical system to the extent required to enable the Owner to identify, service, repair or modify the new wiring system efficiently and safely.

1.3 STANDARDS

A. Demolition work shall comply with ANSI A10.6, NFPA 241, OSHA, AHERA and all applicable local, state and federal standards and guidelines.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that utilities in work area have been disconnected and capped as required.

B. Survey existing conditions and correlate with demolition and new work indicated in Contract Documents to determine extent of demolition required.

C. When unanticipated mechanical, electrical, environmental or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Provide prompt written notice to Engineer of any conflicts.

3.2 DEMOLITION

A. Owner shall retain first right of refusal on all electrical equipment being demolished. Prior to beginning demolition work, contractor shall walk through demolition area with Owner’s representative and identify items to be removed and turned over to Owner. Contractor shall carefully remove, protect and store items to be turned over to Owner and deliver to Owner at location on site as directed by Owner.

B. Maintain services and systems indicated to remain and protect them against damage during demolition process.

C. For all lighting being relocated, remove, clean, re-lamp and reinstall complete as indicated on new work plans.

D. All devices indicated as to remain or to be relocated shall be protected against damage during demolition process and cleaned prior to being restored into service.

E. Contractor shall patch and paint to match adjacent finishes all locations resulting from demolition at which new work is not installed, as required under Section 260500, Electrical,
General.

F. Provide temporary barricades, dust barriers and other protection required to prevent injury to people and damage to building contents, adjacent area of building and facilities to remain.

G. Maintain protected egress and access at all times. Do not close or obstruct roadways or sidewalks without permission from Owner.

H. Conduct demolition to minimize interference with Owner's use of site.

I. Conduct operations with minimum interference to public or private access.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

A. Demolished material shall be promptly removed from site as work progresses.

B. Remove and transport materials in a manner that will prevent contamination or damage to adjacent surfaces and areas.

C. Burning of demolished materials will not be permitted on site.

D. All materials shall be properly and legally disposed of. Contractor is responsible for all handling, storage, transportation and disposal fees.

3.4 CLEANING

A. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations.

B. Return adjacent areas to condition existing before demolition operations began.

END OF SECTION 260510
SECTION 262000 - INTERIOR WIRING SYSTEMS

PART 1 – GENERAL

1.1  RELATED DOCUMENTS

A. Section 260500, Electrical, General, applies to the work under this section.

1.2  SCOPE

A. Provide interior wiring systems complete and ready for operation, as indicated, specified herein and in compliance with applicable codes and standards.

PART 2 – PRODUCTS

2.1  MANUFACTURERS

A. Materials of like type shall be manufactured by the same company.

B. Switchboards, panelboards, circuit breakers, safety switches, transformers, busways, motor starters, contactors and the like: General Electric, Siemens-ITE, Square D, Cutler-Hammer, or approved equal.

C. Fittings, Condulets, Boxes and the like: Steel City, Thomas and Betts, O-Z Electrical Manufacturing Company, Appleton, Efcor, Crouse-Hinds, Garvin Industries, or approved equal.

D. Conductors and Cables: Alpha Wire Company, Belden, Cerro Wire, Southwire Company, General Cable or approved equal.

E. Cable Markers: 3M Company, E-Z Code, Brady, or approved equal.

F. Connectors, Lugs and Terminals and the like: 3M Company, Ideal, Thomas and Betts, O-Z Electrical Manufacturing Company, or approved equal.

G. Wiring Devices and the like: Best Specification Grade; Arrow Hart/Cooper, Hubbell, Legrand/P&S, Leviton, or approved equal.

H. Fuses: Dual-Element type, "Fusetron" by Bussman or "Econ" by Economy or approved equal.

I. Manufactured Wiring Systems: Reloc, AFC Cable Systems, Walkerflex, or approved equal.

J. Grounding Devices, and the like: Cadweld, Thomas and Betts, Appleton, Erico, O-Z Electrical Manufacturing Company, or approved equal.

K. AC and MC Cable: Only permitted for fixture “whips”, maximum 6’ length.

2.2  CONDUIT AND FITTINGS

A. Rigid Steel Conduit (Zinc-Coated): ANSI C80.1.
B. Rigid Nonmetallic Conduit: PVC Type EPC-40 in accordance with NEMA TC2.

C. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.

D. Electrical Metallic Tubing (EMT): ANSI C80.3.

E. Flexible Metal Conduit: UL 1.
   1. Liquid-Tight Flexible Metal Conduit (Steel): UL 360.

F. Fittings for Metal Conduit, Electrical Metallic Tubing, and Flexible Metal Conduit: UL 514. All ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514.
   1. Fittings for rigid metal conduit and IMC shall be threaded type. Split couplings are not acceptable.
   2. Fittings for electrical metallic tubing (EMT) shall be the compression type.


H. Electrical Nonmetallic Tubing (ENT): Not permitted.

2.3 OUTLET BOXES AND COVERS

A. UL 514, cadmium- or zinc-coated if of ferrous metal.

B. Provide outlet boxes of size and type required by NEC, and in no case smaller than the following:
   1. Boxes for lighting fixtures: 4" octagonal x 1-1/2" deep, or 4" x 4" x 1-1/2"
   2. Boxes for Switches and Receptacles: 3" x 2" x 2-3/4" or 4" x 4" x 1-1/2" with plaster ring to suit construction
   3. Telephone boxes: 4" x 4" x 2-1/4"
   4. Communications Systems Boxes: 4" x 4" x 2-1/4"

C. Provide suitable extensions, rings or subcovers set to come flush with the finished surface in which boxes are mounted.

D. Boxes for exposed raceway shall be threaded-hub cast metal, sizes as specified above.

E. Floor Outlet Boxes: Boxes shall be adjustable and concrete tight. Each outlet shall consist of a metal body with openings for conduits, adjustable ring, flange ring, and cover plate. Gaskets shall be used where necessary to ensure watertight installation. See drawings for specific types.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

A. UL 50, hot-dip zinc-coated, code gauge sheet steel, screw cover unless indicated otherwise.
2.5 WIRES AND CABLES

A. Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. All wire and cable shall be new, with size, grade of insulation, voltage and manufacturer's name permanently imprinted on outer covering at regular intervals and delivered to the job site in complete coils and reels.

B. Conductors: Conductors No. 10 AWG and smaller shall be solid, and those No. 8 AWG and larger shall be stranded. Unless indicated otherwise, conductor sizes shown are based on copper. All conductors shall be copper.

C. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy remote-control and signal circuits, No. 16 AWG. All 120 v. branch circuits exceeding 100' in length and all 277 v. branch circuits exceeding 250' in length shall be No. 10 AWG, minimum.

D. Color Coding: Provide for all service, feeder, branch, control and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the neutral of the higher-voltage system shall be white with a yellow stripe or shall be gray. The color of the ungrounded conductors in different voltage systems shall be as follows:

1. 120/208 volt, 3-phase: Phase A - black
   Phase B - red
   Phase C - blue
2. 277/480 volt, 3-phase: Phase A - brown
   Phase B - orange
   Phase C - yellow
3. 120/240 volt, single phase: red and black.
4. On 3-phase, 4-wire delta systems, the high leg shall be orange as required by NFPA 70 and shall be located in enclosures as required by applicable codes.

E. Color coding for fire alarm conductors shall be the manufacturer’s standard and shall be consistent throughout the system. Include color coding key with record data.

F. Insulation: Unless specified or indicated otherwise, or required to be otherwise by NFPA 70, all power and lighting wires shall be 600-volt, Type THHN, THWN, or XHHW; remote-control and signal circuits shall be Type TW, THHN, TF, THWN or XHHW.

G. Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger.

H. Variable Frequency Drive (VFD) Cable:

1. Provide VFD Cable for connection between all variable frequency drives and motors.
2. Cable shall comply with ICEA Standard S-73-532, UL 1685 and IEEE 1202/383 Flame Test. TC-ER cables shall comply with UL 44 and UL1277; stranded copper conductors with ASTM B-3 and B-8.
3. Cable shall be designed and manufactured specifically for application with variable frequency drives, shall be copper and include appropriate ground and symmetrical shielding conductors.


J. Nonmetallic-Sheathed Cable: Not permitted.

2.6 ELECTRICAL CONNECTIONS

A. Comply with NEC Article 110-14.

B. All termination devices, such as connectors, splicing devices, equipment terminals, device terminals and the like shall be rated and listed for operation at 75 degrees C.

2.7 SPLICES AND TERMINATION COMPONENTS

A. UL 486A and UL 486B, as applicable for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller shall be insulated pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

B. Splices and/or taps for #8 and larger conductors shall be crimp type by T&B, Burndy, Oz, or approved equal; or Ilsco KUP-L-Tap®, ClearTap, or approved equal.

2.8 DEVICE PLATES

A. Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be urea or phenolic, minimum 0.10 inch wall thickness, and shall be the same color as the receptacle or toggle switch with which it is mounted, or shall be satin finish stainless steel or brushed-finish aluminum, minimum of 0.03 inch thick as directed by Architect. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plated will not be permitted. Plates installed in wet locations shall be gasketed. All plates shall be oversize type.

2.9 SWITCHES

A. Toggle Switches: Fed. Spec. W-S-896, totally enclosed with bodies of thermosetting plastic and a mounting strap. Handles shall be white, gray, brown or ivory. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type ac only, 120/277 volts, with the current rating and number of poles indicated. Colors shall be as directed by Architect.

B. Disconnect Switches: NEMA KS1. Provide heavy duty, fusible type. General duty and non-fusible switches are not permitted.

1. Operating mechanisms shall be of the quick-make, quick-break type, with arc-suppressing characteristics.
2. Enclosures shall be NEMA 1 indoors and NEMA 3R outdoors and in wet locations unless otherwise indicated, equipped with cover interlock and provisions for padlocking operating handle in **OFF** position. Safety switches shall be by the same manufacturer as panelboards.

3. Safety switches used as motor disconnection means and located on load side of variable frequency drives (VFDs) shall be provided with factory mounted auxiliary contacts to allow communication of switch position to VFD.

### 2.10 RECEPTACLES

A. **NEMA WD1**, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of white, gray, brown or ivory thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap. Colors shall be as directed by Architect with the exception of devices connected to the emergency power system, which shall be **red** in color.

B. **Weatherproof Receptacles**: In all damp or wet locations, provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a gasketed cap over each receptacle opening. The cap(s) shall be provided with a spring-hinged flap. Cover shall be “in use” type where required by local codes. Receptacle shall be UL listed for use in “damp location” or “wet location” to suit installation location.

C. **Ground Fault Circuit Interrupter Receptacles**: UL 943, and shall be duplex type for mounting in a standard outlet box. The device shall be capable of detecting a current leak of 5 milliamperes.

D. Receptacles shall be by same manufacturer as toggle switches, as specified above.

E. Install grounding type receptacles with the grounding terminal at the top.

### 2.11 PANELBOARDS

A. UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker equipped unless indicated otherwise. Design shall be such that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where “space only” is indicated, make provisions for the future installation of a breaker sized as indicated. Directories shall be typed to indicate load served by each circuit and mounted in a holder behind transparent protective covering. Directory listing for each breaker shall list the type load served (lighting, receptacles, etc.) and location of load (room name, room number, etc.)

B. Panelboard Buses: Support bus bars on bases independently of the circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide an isolated neutral bus in each panel for connection of circuit neutral conductors. Provide a separate ground bus marked with a green stripe along its front and bonded to the steel cabinet for connecting grounding conductors.

C. **Circuit Breakers**: Fed. Spec. W-C-375 thermal magnetic type with interrupting capacity as indicated or of 10,000 amperes symmetrical minimum. Breaker terminals shall be UL listed as...
suitable for the type of conductor provided. Plug-in circuit breakers shall be provided only where indicated in drawings.

1. Multi-pole Breakers: Provide common-trip type with a single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2. Circuit Breaker with Ground-Fault Circuit Interrupter: UL 1053 and NFPA 70. Provide with “push-to-test” button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.


4. Breakers Used as Switches for 120-Volt Fluorescent Fixtures: Breakers shall be marked “SWD” in accordance with UL 489.

5. Breakers used to serve refrigeration and air conditioning compressors shall be type “HACR.”

D. Construction:

1. All panelboards shall have hinged, lockable front covers. All panelboard locks included in the project shall be keyed alike and each shall be provided with two (2) keys.

2. For surface-mount fronts, match box dimensions; for flush-mounted fronts, provide cover with overlap trim. Trims shall cover all live parts and shall have no exposed hardware.

E. Panelboards shall be rated for environmental conditions at location where installed:

1. Indoors, dry and clean conditions: NEMA 250, Type 1.
2. Outdoors, NEMA 250, Type 3R
3. Kitchen or wash-down areas: NEMA 250, Type 4X
4. Other wet or damp indoor locations: NEMA 250, Type 4
5. Indoor locations subject to dust, falling dirt and dripping noncorrosive liquids: NEMA 250, Type 5
6. Pump stations, lift stations, vicinity of wastewater, pool equipment or similar corrosive environments: NEMA 250, Type 4X, Stainless Steel.

2.12 FUSES

A. Provide a complete set of fuses for each fusible device provided. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation; submit coordination data for approval. Fuses shall have a voltage rating not less than the circuit voltage.

B. Cartridge Fuses, Current-Limiting Type (Class R): UL 198E, time-delay type. Associated fuseholders shall be Class R only.

C. Cartridge Fuses, Current-Limiting Type (Classes J and L): UL 198C, Class J for 0 to 600 amps and Class L for 601 to 6000 amps.
PART 3 – EXECUTION

3.1 RACEWAYS

A. Provide raceways for all conductors and cables. See drawings for raceway color coding and types approved for various locations and applications in the project.

B. Provide flexible metal conduit for connection to rotating or vibrating equipment. In all potentially wet locations, provide waterproof flexible conduit. In no case shall length of flexible conduit exceed 3 feet, except for transformers, where length shall not exceed 2 feet. Support in accordance with NEC and as approved by Engineer.

C. Contractor shall size pull and junction boxes. Comply with requirements for dimensions and conduit spacings as defined in the NEC Article 314.

D. Raceways shall be continuous between outlets and enclosures. Bond raceway system as described in drawings and grounding specifications and make all connections wrench tight for electrical continuity. Connect raceways at boxes and enclosures using locknuts and bushings. Provide insulating bushings with grounding lug on all raceways one inch and larger.

E. Install raceways generally as follows:

1. Run concealed raceways in straight lines with long sweep bends and offsets.
2. Where raceways turn up out of floor, curved portion shall not be visible.
3. Run exposed raceways parallel and perpendicular with building lines. Strap with two-hole flat straps; do not use minerallac straps.
4. Support raceways within 3' of each outlet box, fitting, or enclosure, and at 10' intervals. Use malleable iron or stamped steel clamps for branch circuit raceways; use pipe hangers for feeder raceways. Do not hang conduit with wire, perforated strap, or nails.
5. Cut all joints square, thread, ream and draw tight. Make bends and offsets with standard conduit ells or with an approved bender or hickey.
6. No more than three quarter-bends equivalent in any run.
7. Cap raceway ends to prevent entrance of debris during construction. Cap with approved pennies, plastic caps or covers; do not tape.
8. Complete raceway installation and clean thoroughly before pulling conductors.
9. Where conduits pass through fire-rated walls and/or floors, provide a UL-listed through-penetration assembly with fire rating equal to wall or floor penetrated. Materials shall be by 3M Company or equal. Each assembly shall be specific to the penetrating device, e.g., single conduit, multiple conduits, busway, etc. and shall be specific to the wall or floor construction penetrated, e.g., concrete, gypsum board on wall studs, etc. Install assemblies in accordance with material manufacturer's instructions and UL Building Materials Directory, latest edition.
10. Install expansion fittings with copper bonding jumpers in conduit runs which cross building expansion joints.
11. Ferrous metal raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, metal elbows, couplings, nipples, fittings, supports, and support hardware shall be suitably protected against corrosion inside and outside (except threads at joints) by a coating of approved corrosion-resistant material (Thomas & Betts, Kopr-Shield, or equal). Where corrosion protection is necessary and the conduit is threaded in
the field, the threads shall be coated with an approved electrically conductive, corrosion-resistant compound.

F. Install pull boxes as shown in drawings and as required to pull conductors without damage to insulation. Provide pull boxes in accessible locations only, and size in accordance with NEC.

G. Unless otherwise indicated, underground service entrance conduits may be Schedule 40 PVC or coal-tar painted IMC or coal-tar painted GRS conduit at the contractor's option. All elbows shall be GRS type. Maintain conduit spacing in compliance with NEC.

H. Cover all raceways below grade and in concrete slabs with two brushed applications of a coal tar base coating conforming to MIL-C-18480. In lieu of asphalt coated conduit, Schedule 40 PVC conduit may be used for branch circuit raceways (conduits 1" and smaller), provided that grounding conductors are provided in all runs sized per NEC.

I. At Contractor’s option, Schedule 40 PVC conduit may be used for underground feeder raceways, provided that GRS elbows and grounding conductors are provided for all runs. Exposed conduits shall be metallic as specified. All feeder and branch circuit raceways shall be metallic and shall be provided with green ground conductor in accordance with NEC Article 517, redundant grounding requirements.

J. Install raceways of sizes shown in drawings and comply with Table 1 of NEC (latest edition). In case of conflict, install larger size.

K. Provide in each empty raceway a pull cord or wire, identified with a cardboard tag as to location of equipment or outlet fed by conduit.

3.2 OUTLET, SWITCH, AND JUNCTION BOXES, FITTINGS

A. Provide outlet and junction boxes as required for power, lighting, and communications systems as shown in drawings.

B. Boxes shall be held securely in place by being imbedded in masonry or shall be secured to a fixed structural unit such as a stud or joist.

3.3 CONDUCTORS

A. Provide conductors in raceways as shown in drawings for service, feeders and branch circuits.

B. Conductors No. 8 and larger shall be connected to equipment by means of pressure type mechanical lugs. Where multiple conductors are connected to the same terminal each conductor shall be provided with an individual lug.

C. Soldered splices shall be made mechanically secure before soldering.

D. Wire and cable shall be suitably protected from weather during storage and handling and shall be in good condition when installed.
E. Join conductors with approved connectors, or by soldering, brazing or welding. Tape all connections or cover with approved prefabricated insulating devices to provide insulation resistance at the connection equal to that of the wire. Make splices in boxes or fittings only.

F. Do not pull conductors before completion of masonry, concrete and other trades which generate dust and debris. See raceways section, above.

G. Install and terminate variable frequency drive cable in accordance with manufacturer guidelines. Shield and ground conductors shall be securely bonded to motor case and drive enclosure to ensure control of ground current and electrical noise.

3.4 PANELBOARDS

A. Where shown on drawings and indicated in riser diagram, provide panelboards of the types and sizes indicated. Panelboards shall be installed with top of cabinet 72” above finished floor.

B. Comply with NFPA-70, Section 408, for installation requirements and with other applicable sections for clearances. Lay out all equipment rooms in advance of roughing and notify Engineer immediately, in writing, if interferences are encountered or if code requirements cannot be met with equipment proposed.

C. Provide multi-pole breakers of common-trip type to simultaneously disconnect all ungrounded conductors in multiwire branch circuits.

3.5 SAFETY SWITCHES

A. Provide heavy duty, fusible safety switches as shown on drawings and in accordance with NEC requirements. Provide nameplates on switches as specified in Section 260500. Wording shall identify the load which switch disconnects.

B. Coordinate switch locations with all trades and install so that adequate workspace and clearance is provided to allow for safe access. Comply with NEC Article 110 requirements.

C. For switches used as motor disconnects on load side of variable frequency drives, provide signaling cable as required from VFD to auxiliary contacts in safety switch. Connect complete.

3.6 SWITCHES AND RECEPTACLES

A. Provide switches and receptacles for power and lighting as shown in drawings. Where indicated, verify location of receptacles with Owner prior to roughing.

B. Gang plates where two or more devices occur at the same location. Verify locations in relation to door swings, and place devices on the strike side.

C. Install devices at locations indicated in details.

D. Install outlets and devices plumb, level and with positioning at roughing to suit final wall covering. Device plates shall contact finished walls all-around on all four sides.
E. Protect devices during painting and clean-up of job. Leave devices clean and free from paint, dirt and debris.

F. Prior to final completion, check all receptacles for shorts, opens and grounds and correct all incorrect connections. Use receptacle checker as manufactured by Daniel Woodhead Company, General Electric, Leviton, or equal.

3.7 GROUNDING

A. Provide grounding system to comply with NEC, as shown on drawings and as specified.

B. All ground rods and fittings used shall be free from paint, grease, and other poorly conducting material, and contact surfaces shall be cleaned thoroughly to ensure good metal-to-metal contact.

C. Install bonding jumpers between all panelboards and feeder raceways connected thereto; across pull box and raceway expansion joints and across water meters located within buildings.

D. All connections to grounding conductors shall be accessible for inspection and shall be made with solderless connectors brazed or bolted to the equipment or structure to be grounded. Unless otherwise indicated in drawings, grounding conductors within raceway system shall be installed in exposed rigid steel conduit with both conductor and conduit bonded at each end. Do not cover main service grounding until Engineer has observed connections.

E. Provide a ground wire in all circuits sized per NEC Table 250-122 as applicable.

F. Provide in all runs of flexible conduit a separate grounding conductor sized per NEC Table 250-122.

END OF SECTION 262000
SECTION 264313 - SURGE PROTECTION DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide an operational Transient Voltage Surge Suppression System (TVSS) for protection of selected sections of facility’s AC Distribution System utilizing Surge Protective Devices (SPDs).

B. Provide all labor, materials and equipment as required for a complete and operational surge protection system.

1.3 APPLICABLE CODES AND STANDARDS

A. In addition to the codes and standards listed in Section 26 05 00, the latest editions of the following codes and standards apply to this work:

1. UL 1449, Third Edition; UL 1283, Fifth Edition
3. MIL-STD 220A - Electrical Line Noise Attenuation
4. NFPA 70, Article 285 – Surge-Protective Devices (SPDs), 1kV or Less
5. UL96A – Requirements for Master Label Certificates (Lightning Protection)
6. IEEE 1100 (Emerald Book)

1.4 WARRANTY

A. Provide a minimum full five-year manufacturer’s warranty against failure for each unit installed.

PART 2 – PRODUCTS

2.1 MATERIALS/CONSTRUCTION

A. SPDs shall be of solid state, hybrid, parallel circuit design; series elements will not be accepted.

B. SPDs shall protect all modes: L-L, L-N, L-G (N-G where applicable).

C. Service entrance SPDs shall incorporate hybrid 2-tier design utilizing metal oxide varistors and filter capacitors. Units shall contain modular, field replaceable surge devices and shall incorporate integral disconnection means and internal fusing to allow direct connection to switchgear bussing.
D. Distribution and Branch Circuit SPDs shall incorporate hybrid 2-tier design utilizing metal oxide varistors and filter capacitors.

E. Response time of all suppression components shall be equal to or less than one (1) nanosecond as measured with 6-inch lead length.

F. The TVSS system shall provide a joule rating that meets or exceeds ANSI/IEEE C62.41 Category C requirements.

G. SPDs shall have indicator status lights that monitor the operational status of the device.

H. All SPDs with the exception of point of use models shall include form C contacts for remote monitoring.

I. SPDs shall have a pulse life equal to or greater than 1,000 sequential ANSI/IEEE Category C waveforms. Submit certified test reports if requested by Engineer.

J. The TVSS surge current capacity of each SPD shall be equal to or greater than:

<table>
<thead>
<tr>
<th>Distribution Panel</th>
<th>Phase</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>277/480 v.</td>
<td>200K</td>
<td>100K</td>
</tr>
</tbody>
</table>

K. The SPD suppression (clamping) voltage, in accordance with UL 1449, Third Edition, shall not exceed:

<table>
<thead>
<tr>
<th>Distribution Panel</th>
<th>L-L</th>
<th>L-N</th>
<th>L-G</th>
<th>N-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>277/480 v.</td>
<td>2000</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
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</table>

L. SPDs for Branch Circuit Panels shall incorporate sine wave tracking for electrical noise filtering.

M. SPDs shall be stand alone type. SPDs integral to switchgear or panelboards are not permitted.

N. SPD Short Circuit Current Rating (SCCR) shall exceed the available short circuit current at the point of attachment.

O. SPD Devices shall meet UL Certification code VZCA and listed as Suitable for LPS or TVSS.Arrester as designated by UL.

2.2 MANUFACTURERS

A. Current Technology, Thor Systems, LEA International or Liebert. No substitutions permitted.

B. All SPD devices shall be from the same manufacturer.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide SPDs at switchgear units, motor control centers, panelboards, and outlets as indicated.

B. For service entrance SPDs, provide lugs on gear bussing to allow direct connection.

C. Install strictly in accordance with manufacturer’s recommendations. Wire lead length shall be equal to or less than manufacturer’s recommended lengths and shall be kept as straight as possible.

D. Provide overcurrent protection in current ratings and number of poles per manufacturer’s instructions and in accordance with the National Electrical Code.

END OF SECTION 26 43 13