



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

**STANDARD LOW BID PROJECT – INVITATIONAL
Project Budgets \$50,000 - \$100,000**

March 30, 2009

**HEAT PLANT CATWALK & STEAM TUNNEL
EMERGENCY LIGHTING**

SOUTHERN UTAH UNIVERSITY

CEDAR CITY, UTAH

DFCM Project Number 08110730

WHW Engineering
8619 South Sandy Parkway, Suite 101
Sandy, Utah 84070

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM.

DFCM Supplemental General Conditions dated July 15, 2008
DFCM General Conditions dated May 25, 2005.
DFCM Application and Certification for Payment dated May 25, 2005.

Technical Specifications : attached and dated
Drawings: attached and dated

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

INVITATION TO BID

Only firms that have been invited to submit bids on this project are allowed to bid on this project.

Sealed bids will be received by the Division of Facilities Construction and Management (DFCM) for:

HEAT PLANT CATWALK & STEAM TUNNEL EMERGENCY LIGHTING
SOUTHERN UTAH UNIVERSITY – CEDAR CITY, UTAH
DFCM PROJECT NO: 08110730

<u>Company</u>	<u>Contact</u>	<u>Fax</u>
Carter Enterprise	Curtis Carter	435-586-0083
Dual A Construction	Aaron Ashworth	435-867-4616
Velocity Construction	Spencer Jones	435-586-4968
Big D Construction	Brian Hatch	801-769-7353

Bids will be in accordance with the Contract Documents that will be available on **Monday, March 30, 2009**, and distributed in electronic format only on CDs from DFCM, 4110 State Office Building, Salt Lake City, Utah and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Jeff Reddoor, DFCM, at 801-971-9830. No others are to be contacted regarding this bidding process. The construction estimate for this project is \$ 100,000.00.

A **mandatory** pre-bid meeting will be held at **10:00 AM on Wednesday, April 1, 2009** at SUU-New Facility Management Building. All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of **2:00 PM on Monday, April 13, 2009** at DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. NOTE: Bids must be received at 4110 State Office Building by the specified time.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction and Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of DFCM.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

Joanna Reese, Contract Coordinator
4110 State Office Building, Salt Lake City, Utah 84114

PROJECT DESCRIPTION

Remove and replace existing catwalk system in heat plant as well as install new emergency lighting for steam tunnel.

**PROJECT SCHEDULE**

**PROJECT NAME: HEAT PLANT CATWALK & STEAM TUNNEL EMERGENCY LIGHTING
SOUTHERN UTAH UNIVERSITY – CEDAR CITY, UTAH
DFCM PROJECT NO. 08110730**

Event	Day	Date	Time	Place
Bidding Documents Available	Monday	March 30, 2009	12:00 Noon	DFCM 4110 State Office Bldg SLC, UT and the DFCM web site *
Mandatory Pre-bid Site Meeting	Wednesday	April 1, 2009	10:00 AM	SUU – New Facility Mngt Building, Cedar City
Last Day to Submit Questions	Monday	April 6, 2009	2:00 PM	Jeff Reddoor – DFCM E-mail jreddoor@utah.gov Fax 435-743-6624
Addendum Deadline (exception for bid delays)	Tuesday	April 7, 2009	4:00 PM	DFCM web site *
Prime Contractors Turn In Bid and Bid Bond	Monday	April 13, 2009	2:00 PM	DFCM 4110 State Office Bldg SLC, UT
Sub-contractor List Due	Tuesday	April 14, 2009	2:00 PM	DFCM 4110 State Office Bldg SLC, UT Fax 801-538-3677
Substantial Completion Date	Tuesday	June 30, 2009	5:00 PM	

* **NOTE:** DFCM's web site address is <http://dfcm.utah.gov>



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the Heat Plant Catwalk & Steam Tunnel Emergency Lighting – Southern Utah University – Cedar City, Utah – DFCM Project No. 08110730 and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$_____)

(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by June 30, 2009,, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of \$200.00 per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor’s Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature

INSTRUCTIONS TO BIDDERS

1. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Invitation to Bid.

2. Bids

Before submitting a bid, each contractor shall carefully examine the Contract Documents, shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the deadline for submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a bid bond form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **NOTE: A cashier's check cannot be used as a substitute for a bid bond.**

3. Contract and Bond

The Contractor's Agreement will be in the form found in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the contract sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for subcontractors will be specified in the Supplementary General Conditions.

4. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the “Instructions and Subcontractor’s List Form”, which are included as part of these Contract Documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contracts for a period of up to three years.

5. Interpretation of Drawings and Specifications

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Project Manager a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addenda posted on DFCM’s web site at <http://dfcm.utah.gov>. Neither the DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

6. Addenda

Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

7. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

8. DFCM Contractor Performance Rating

As a contractor completes each DFCM project, DFCM, the architect/engineer and the using agency will evaluate project performance based on the enclosed “DFCM Contractor Performance Rating” form. The ratings issued on this project will not affect this project but may affect the award on future projects.

9. Licensure

The Contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

10. Permits

In concurrence with the requirements for permitting in the General Conditions, it is the responsibility of the Contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the Contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

11. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

12. Time is of the Essence

Time is of the essence in regard to all the requirements of the Contract Documents.

13. Withdrawal of Bids

Bids may be withdrawn on written request received from bidder prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

14. Product Approvals

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of

the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

15. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the contractor, subcontractor or sub-subcontractor.

16. Debarment

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by DFCM as part of the requirements for award of the Project.

BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ _____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____.

Principal's name and address (if other than a corporation):

By: _____

Title: _____

Principal's name and address (if a corporation):

By: _____

Title: _____
(Affix Corporate Seal)

Surety's name and address:

By: _____
Attorney-in-Fact (Affix Corporate Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this ___ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.
My Commission Expires: _____
Resides at: _____

Agency: _____
Agent: _____
Address: _____
Phone: _____

NOTARY PUBLIC

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General



Division of Facilities Construction and

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

DOLLAR AMOUNTS FOR LISTING

PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

GROUNDS FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM
Page No. 2

such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self" *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

* Bidders may list "self", but it is not required.

PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.



SUBCONTRACTORS LIST
FAX TO 801-538-3677

PROJECT TITLE: _____

Caution: You must read and comply fully with instructions.

Table with 4 columns: TYPE OF WORK, SUBCONTRACTOR, 'SELF' OR 'SPECIAL EXCEPTION', SUBCONTRACTOR BID AMOUNT, CONT. LICENSE #

We certify that:

- 1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed 'Self' or 'Special Exception' in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____

SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR OWNER'S REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY OWNER. ATTACH A SECOND PAGE IF NECESSARY.

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and Supplemental General Conditions dated July 15, 2008 ("also referred to as General Conditions") on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ DOLLARS AND NO CENTS (\$_____.00), which is the base bid, and which sum also includes the cost of a 100% Performance Bond and a 100%

CONTRACTOR'S AGREEMENT
PAGE NO. 2

Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete by _____. Contractor agrees to pay liquidated damages in the amount of \$_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Invitation to Bid, Instructions to Bidders/ Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to

safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

PERFORMANCE BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____

(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____

Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____ (Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____ Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____
Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General



CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

The Owner acknowledges receipt of the following closeout and transition materials:

- As-built Drawings O & M Manuals Warranty Documents Completion of Training Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of _____(Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$_____. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

CONTRACTOR (include name of firm) by: _____ (Signature) DATE

A/E (include name of firm) by: _____ (Signature) DATE

USING INSTITUTION OR AGENCY by: _____ (Signature) DATE

DFCM (Owner) by: _____ (Signature) DATE

**General Contractor Performance Rating Form**

Project Name:		DFCM Project#	
Contractor: (ABC Construction, John Doe, 111-111-1111)	A/E: (ABC Architects, Jane Doe, 222-222-2222)	Original Contract Amount:	Final Contract Amount:
DFCM Project Manager:		Contract Date:	
Completion Date:		Date of Rating:	

Rating Guideline	QUALITY OF PRODUCT OR SERVICES	COST CONTROL	TIMELINESS OF PERFORMANCE	BUSINESS RELATIONS
5-Exceptional	Contractor has demonstrated an exceptional performance level in any of the above four categories that justifies adding a point to the score. Contractor performance clearly exceeds the performance levels described as "Very Good"			
4-Very Good	Contractor is in compliance with contract requirements and/or delivers quality product/service.	Contractor is effective in managing costs and submits current, accurate, and complete billings	Contractor is effective in meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is effective
3-Satisfactory	Minor inefficiencies/errors have been identified	Contractor is usually effective in managing cost	Contractor is usually effective in meeting milestones and delivery schedules	Response to inquires technical/service/administrative issues is somewhat effective
2-Marginal	Major problems have been encountered	Contractor is having major difficulty managing cost effectively	Contractor is having major difficulty meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is marginally effective
1-Unsatisfactory	Contractor is not in compliance and is jeopardizing achievement of contract objectives	Contractor is unable to manage costs effectively	Contractor delays are jeopardizing performance of contract objectives	Response to inquiries, technical/service/administrative issues is not effective

1. Rate Contractors quality of workmanship, management of sub contractor performance, project cleanliness, organization and safety requirement.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

2. Rate Contractor administration of project costs, change orders and financial management of the project budget.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

3. Rate Contractor's performance and adherence to Project Schedule, delay procedures and requirements of substantial completion, inspection and punch-list performance.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

4. Evaluate performance of contractor management team including project manager, engineer and superintendent also include in the rating team's ability to work well with owner, user agency and consultants.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

5. Rate success of Contractor's management plan, completion of the plans mitigation of project risks and performance of value engineering concepts.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

Signed by:	Date:	Mean Score
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Additional Comments:

SOUTHERN UTAH UNIVERSITY CATWALK AND STEAM TUNNEL EMERGENCY LIGHTING

DFCM PROJECT # 08110730



State of Utah—Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

4110 State Office Building / Salt Lake City, Utah 84114 / 538-3018

SPECIFICATIONS

PREPARED BY

**WHW ENGINEERING INC.
8619 SOUTH SANDY PARKWAY, SUITE 101
SANDY, UTAH 84070
PHONE: (801) 466-4021
FAX: (801) 466-8536**

March 2009

WHW Engineering Project # 08017

DIVISION 1 - GENERAL REQUIREMENTS

01100 SUMMARY

DIVISION 3 - CONCRETE

03300 CAST IN PLACE CONCRETE

DIVISION 5 – METALS

05500 METAL FABRICATIONS

DIVISION 9 – FINISHES

09900 PAINTING

DIVISION 15 - MECHANICAL

15010 GENERAL REQUIREMENTS

15050 BASIC MECHANICAL MATERIALS & METHODS

DIVISION 16 – ELECTRICAL

16050 BASIC ELECTRICAL MATERIALS AND METHODS

16060 GROUNDING AND BONDING

16071 SEISMIC CONTROLS FOR ELECTRICAL WORK

16075 ELECTRICAL IDENTIFICATION

16120 CONDUCTORS AND CABLES

16130 RACEWAYS AND BOXES

16410 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

16442 PANELBOARDS

16511 INTERIOR LIGHTING

DIVISION 1
GENERAL REQUIREMENTS

01100 SUMMARY OF WORK

SECTION 01100 - SUMMARY OF THE WORK

PART 1 - GENERAL

1.1 Descriptive Summary of the Work:

- A. Without force and effect on the requirements of the Contract Documents, the description of the work of the Contract is summarized as follows:

1.2 Scope of the Work:

- A. Provide new catwalks, handrails midrails, toe plates etc.
- B. Remove all existing handrails and replace with code approved catwalks, handrails, midrails, toe plates, etc.
- C. Remove and replace all existing 2'-0" wide catwalks with new 2'-6" catwalks, handrails, midrails, toe plates, etc.
- D. Remove existing catwalks that are no longer needed.
- E. Provide new ladders and provide safety cages on existing ladders.
- F. Provide new steam tunnel emergency lighting. See Electrical.
- G. The contractor is responsible for the complete execution of the Contract Documents as indicated and specified. He is responsible for the work performed, the acts and omissions of his sub-contractors and suppliers and of persons either directly or indirectly employed by them, as well as the work, acts and omissions of persons directly employed by him.
- H. Provide, without additional charge, all incidental items required to complete the work even though not specifically indicated. Install all work so that its several component parts function together as a workable system, and with all equipment properly adjusted and in working order.
- I. Conform to the highest quality standards for materials and workmanship as required to execute work indicated, specified and necessary to fully satisfy the Contract requirements for a complete, finished and acceptable installation.
- J. The contractor is responsible to verify all field measurements of actual site conditions so that all work fits properly in the locations indicated and specified. Protect existing structures, improvements, landscaping, etc. from physical damage.
- K. Upon completion of the project, dismantle and remove from the site all barricade and construction materials.
- L. Any existing items which are damaged by the contractor shall be restored to their original or better condition to the satisfaction of the Owner.

1.3 Contractor use of Premises:

- A. General: During the Construction period, the Contractor will have full use of the designated portions of the Owner's property necessary to perform the work, store a reasonable amount of materials, placement of temporary facilities, and similar uses. The Contractor's use of the premises is limited insofar as Owner operations in existing facilities is concerned.
 - 1. The existing campus area will remain fully operational throughout the Construction Period. This work must be conducted in such a manner that no interference with such operations or with the safety of Owner's employees, students or the public.

1.4 Interruption of Existing Utilities:

- A. Whenever the work of this contract requires the temporary shutdown of any existing utilities, notify Physical Facilities Director 72 hours in advance and obtain written permission from him before shutting off any existing utilities. Minimize the interruption of existing mechanical, communications and electrical services which may affect other portions of the University operations.

1.5 Construction Documents:

- A. The Working Drawings constitute the visual construction guide.
- B. Working Drawings and Specifications are complimentary to each other and what is called for by one is as binding as if called for and defined by both. In case of conflict between the two, the Specifications take precedence unless they are obviously in error. Figured dimensions take precedence over scale measurements.
- C. In no case are manufacturer's or supplier's shop drawings to nullify, take precedence of, or supplant the Working Drawings.
- D. Specification Divisions are divided into the standard sixteen construction industry major divisions with all work being categorized into one such division. Individual elements of the work are subdivided into sections within each division. Such assignment of the work is not intended to limit the manner in which the Contractor chooses to assign the work.

1.6 Guarantee/Warranty:

- A. Notwithstanding other guarantees or warranties for specific components of the work, the entire work included in this contract shall be guaranteed for a period of one (1) year from the date of issuance of the Certificate of Substantial Completion against all defects in equipment, material, or workmanship.
- B. Furnish and pay for all labor, equipment, and material required to correct defects and deficiencies in the work without additional cost to the Owner and as approved by the Engineer.

- C. In addition to the general project warranty, specific project warranties are required. Requirements of the warranties are noted in the indicated Specification Sections.

PART 2-PRODUCTS

(Not Used)

PART 3-EXECUTION

(Not Used)

END OF SECTION 01100

**DIVISION 3
CONCRETE**

03300 CAST IN PLACE CONCRETE

SECTION 03300 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Concrete for supports of catwalk support piping
 - 2. Form work for support piping foundations.

1.3 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.

1.4 QUALITY ASSURANCE

- A. 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."
- B. Codes and Standards: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 304,
 - 4. ACI 305,
 - 5. ACI 306,
 - 6. ACI 315,
 - 7. ACI 347
 - 8. ASTM
 - 9. 2003 IBC

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

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. Plywood, metal, or other approved panel materials.
- 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.

2.2 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 II or III.
 - a. Fly Ash: ASTM C 618.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33,
 - 1. Maximum Coarse-Aggregate Size: 1 inch
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable as long as it is clean and free from deleterious amounts of impurities likely to be injurious to concrete.

2.3 ADMIXTURES

- A. 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. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 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. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water reducing 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.

2.5 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. When air temperature is between **85 and 90 deg F**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F**, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of **1 cu. yd.** or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than **1 cu. yd.**, increase mixing time by 15 seconds for each additional **1 cu. yd.**
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

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.
 - 1. Limit concrete surface irregularities, designated by ACI 347R.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- E. 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.
- F. Chamfer exterior corners and edges of permanently exposed concrete.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.2 REMOVING AND REUSING FORMS

- A. General: Formwork 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, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- 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 Engineer.

3.3 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. 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. 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.

3.4 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. 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. Structural Foundations: Provide foundations as shown on Drawings. Set anchor bolts at correct elevations.

3.5 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. Formed Surfaces: Cure formed concrete surfaces. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- C. Unformed Surfaces: Begin curing immediately after finishing concrete.

3.6 JOINT FILLING

- A. Prepare, clean, and install joint filler between foundation sides and concrete floor according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.7 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** in any dimension in solid concrete, but not less than **1 inch** in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- C. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

3.8 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:

1. Headed bolts.
 2. Concrete placement.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
- a. Testing Frequency: Obtain one composite sample for each day's pour
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is **40 deg F** and below and when **80 deg F** and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than **500 psi**.
 10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03300

DIVISION 5
METALS

05500 METAL FABRICATIONS

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel framing and supports for new catwalks.
 - 2. Steel framing and supports existing catwalks.
 - 3. Metal ladders.
 - 4. Pipe handrails, midrails and toe plates.
 - 5. Metal floor plates and supports.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts indicated to be cast into concrete.
- C. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of new and existing catwalks with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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.
- B. Coordinate installation of steel weld plates and bolts for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

- A. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 307, Grade A** with hex nuts, **ASTM A 563** and, where indicated, flat washers.
- B. Plain Washers: Round, **ASME B18.22.1**
- C. Lock Washers: Helical, spring type, **ASME B18.21.1**

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 3.5 lb/gal. or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
1. Use primer with a VOC content of 3.5 lb/gal. or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. Carboline Company; Carbozinc 621.
 - c. ICI Devoe Coatings; Catha-Coat 313.
 - d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
 - g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of **3000 psi**, unless otherwise indicated.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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 metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch**, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with 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.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing for new and upgraded catwalks not specified in other Sections as needed to complete the Work.
- B. Fabricate frames from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 STEEL WELD PLATES

- A. Provide steel weld plates not specified in other Sections, for items supported from concrete construction as needed to complete the Work.

2.9 METAL LADDERS

- A. General:
1. Comply with ANSI A14.3, unless otherwise indicated.
 2. Comply with detail on drawings.
 3. Space siderails **16 inches** apart, unless otherwise indicated.
 4. Support each ladder at top and bottom and not more than **60 inches** o.c. with welded or bolted brackets, made from same metal as ladder. See detail on drawings.
- B. Steel Ladders:
1. Siderails: Continuous, **3/8-by-2-1/2-inch** steel flat bars, with eased edges.
 2. Rungs: **3/4-inch-** steel rods.
 3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 5. Products:
 - a. IKG Industries, a Harsco company; Mebac.
 - b. W. S. Molnar Company; SlipNOT.
 6. Prime interior ladders including brackets and fasteners, with zinc-rich primer.

7. Provide protective cages as shown on the drawings.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- C. Paint Stingers on ladders silver and rungs black.
- D. All Catwalk new and existing shall be painted silver along with all accessories, supports etc.
- E. Grating for catwalk shall come painted black from factory.
- F. Horizontal top rail and midrail shall be painted black. All other posts, toe plate etc. shall be painted silver.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- C. 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.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support catwalks using steel pipe columns.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.
- B. Touchup Painting: Clean and provide touchup painting of field welds, bolted connections, and abraded areas of shop paint.

END OF SECTION 05500

**DIVISION 9
FINISHES**

09900 PAINTING

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Scope:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
 - 2. All exposed steel, i.e. new catwalk catwalks piping supports, structural supports, catwalks, ladders, handrails, midrails, posts and stairs.

1.2 DESCRIPTION OF WORK

- A. Work includes field painting of exposed hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under electrical work and as noted in scope above.
- B. "Paint" as used herein, means all coating systems materials, primers, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.
- C. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, engineer will select these from standard colors or finishes available.
- D. Following categories of work are not included as part of field-applied finish work.
 - 1. Pre-finished Items: Unless otherwise indicated, do not include painting when factory-finishing is specified.
 - 2. Finished Metal Surfaces: Unless other wise indicated, metal surfaces of anodized aluminum, chromium plate, bronze and similar finished materials will not require finish painting.
- E. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.5 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F and 90 deg F.

- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
 - a. Benjamin Moore and Co. (Moore) or approved equal by.
 - b. Devoe and Reynolds Co. (Devoe).
 - c. The Glidden Company (Glidden).
 - d. Pratt and Lambert (P & L).
 - f. The Sherwin-Williams Company (S-W).
 - g. Kwal-Howells Company
 - h. Prior approved equal.

2.2 MATERIALS

- A. Material Quality: Provide best quality grade of various tubes of coatings as regularly manufactured by acceptable paint materials manufacturer's. Materials

not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

1. Do not use red-lead base paints.

2.3 PAINTING SCHEDULE

A. Catwalks - Silver.

B. Handrails

1. Posts - Silver
2. Top rail - Black
3. Mid rail - Black
4. Toe plate - Silver
5. Grating - Pre painted Black at factory

C. Electrical

1. Match existing color used on campus.

PART 3 - EXECUTION

3.1 INSPECTION

A. Applicator must examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

A. General Procedures: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

1. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Engineer in writing of any anticipated problems in using the specified coating systems with substrates primed by others.
2. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the

items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

3. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
4. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

3.3 MATERIALS PREPARATION

- A. Mix and prepare paint materials in accordance with manufacturer's directions.
 1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 1. Provide finish coats that are compatible with primers used.
 2. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
 3. Sand lightly between each succeeding enamel coat.
 4. Omit primer on metal surfaces that have been shop-primed and touch up painted.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, primed or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- E. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others.
1. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.
- F. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.5 CLEAN-UP AND PROTECTION

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Engineer.
1. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
 2. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Quick-Drying Enamel System: MPI INT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel semigloss.
2. Water-Based Dry-Fall System: MPI INT 5.1C.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Latex dry fog/fall.
3. Alkyd Dry-Fall System: MPI INT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Interior alkyd dry fog/fall.
4. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex semigloss.

END OF SECTION 09900

DIVISION 15
MECHANICAL SPECIFICATION

15010 GENERAL REQUIREMENTS

15050 BASIC MECHANICAL MATERIALS AND METHODS

SECTION 15010 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL:

- A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE:

- A. Includes -
 - 1. Furnish all labor, materials, and equipment necessary for completion of the structural and electrical work for the Southern Utah University Catwalks and Steam Tunnel Emergency Lighting Ventilation.
 - 2. Placing the new installations into full operation.
 - 3. The satisfactory performance of the completed systems is a requirement of this specification.
- B. Related Work Specified Elsewhere -
 - 1. Cable tray conduit, line voltage wiring, outlets, and disconnect switches specified in Division 16.

1.3 SITE INSPECTION:

- A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS:

- A. Mechanical drawings show general arrangement of new and existing catwalks, ladders electrical etc. however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual construction and work of other trades will permit.
- B. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing conditions affecting this work and arrange work accordingly, providing such accessories required to meet conditions.
- C. If changes are required due to lack of coordination of work under this division, such changes shall be made without charge.

1.5 CODE REQUIREMENTS, FEES, AND PERMITS:

- A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.
1. American National Standards Institute (ANSI)
 2. American Society of Mechanical Engineers (ASME)
 4. American Society of Testing Materials (ASTM)
 5. American Standards Association (ASA)
 6. American Welding Society (AWS)
 7. National Electrical Code (NEC)
 8. Underwriters Laboratories (UL)
 10. International Building Code (IBC) 2006 Ed
 11. International Mechanical Code (IMC) 2006 Ed
 12. Utah State Safety Orders (OSHA/UOSH)
 13. Utah Fire Rating Bureau
 14. DFCM and SUU requirements and standards.
 15. ASTM A36/A 36M
 16. ANSI A 14.3
- B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Engineer in writing prior to bidding, otherwise Contractor shall comply with applicable codes.
- C. The latest edition of all codes shall be used.

1.6 OPERATION AND MAINTENANCE MANUAL (ELECTRICAL ONLY):

- A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Engineer, three (3) sets of installation, operating and maintenance manuals and instructions for all new electrical materials used in the tunnel.
- B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The following lettering shall be stamped on front and spine of each binder:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
Southern Utah University Steam Catwalk and Tunnel Emergency Lighting
WHW Engineering Inc.

- C. The first section is to contain the following information.
 - 1. First page shall be a table of contents including name of project, date awarded and date of substantial completion.
 - 2. Second page shall contain the names, phone numbers and addresses of Engineers, Consulting Engineers, and Associates.
 - 3. Third page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
 - 4. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. Location, function and name address and phone number of supplier.
- D. The final sections shall be one for each individual item for which a submittal sheet was required. Each section shall include:
 - 1. Equipment descriptions
 - 2. Detailed installation instruction, operating and maintenance instructions.
 - 3. Name addresses and phone number of electrical manufacturer, fabricator and local vender clearly printed or stamped on cover.
 - 5. Complete electrical parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
 - 6. General product and electrical approved submittal sheets.
- F. Equipment to be covered:
 - 1. Electrical equipment.
 - 2. Any item for which a submittal is required.

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS:

- A. Contractor shall instruct physical facilities personnel in the operation and maintenance of the installed tunnel emergency lighting systems utilizing the Operation and Maintenance Manual when so doing.
- B. Instruction period shall occur before final inspection and before final payment is made.

1.8 RECORD DRAWINGS:

- A. Contractor shall keep an up-to-date set of drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final inspection.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 15010

SECTION 15051 - BASIC MATERIALS & METHODS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL:

- A. General Conditions 01 and Section 15010 General applies to this Section.

1.2 COORDINATION OF WORK:

- A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for the installation of the steam tunnel emergency lighting and the new catwalks, handrails etc. according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to the Engineer in writing. Should conditions arise where certain changes would be advisable, secure Owner's and Engineer's approval for these changes before proceeding with work.
- B. Coordinate work of various trades in installing interrelated work. Changes required in work specified in Division 15 and 16 caused by neglect shall be made at no cost to Owner.
- C. Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Owner and Engineer. Cut carefully to minimize necessity for repairs to existing work.
- E. This Contractor shall schedule his work, store his equipment and materials, and work in harmony with other Contractors so as to not delay or jeopardize the construction.

1.3 EQUIPMENT & MATERIALS:

- A. Requests for substitution shall be received in writing a minimum of seven days prior to bidding. Prior acceptance shall be by Manufacturer's name only. Items not listed in this specification or subsequent addendums shall not be considered. No oral approvals will be acceptable. Manufacturers listed in this specification are acceptable only for items listed. All other items manufacturer wishes to bid must be prior approved. All equipment shall be subject to final review in accordance with "Project Submittals".
- B. Product Approvals -
 - 1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
 - 2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in Specification.
- C. Use domestic made equipment, etc. on project.

- D. Equipment name plates as well as applicable UL labels shall be in place when Project is turned over to Owner.
- E. Insure that items to be furnished fit spaces available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. Do not scale off drawings.
- F. All materials shall be of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended. Materials shall be new unless specifically excepted.
- G. Equipment catalog or model numbers shown define the basic equipment types and quality standard only. Catalog numbers shall not be considered as all inclusive and shall be verified to include all devices, controls, operators, and appurtenances necessary for the satisfactory and complete operation of the equipment.
- H. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.
 - 1. Promptly notify Engineer in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain Engineer's written instructions before proceeding with work. Contractor shall bear all expenses arising from correcting deficiencies of work that does not comply with Manufacturer's directions or such written instructions from.
- I. Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection.

1.4 PROJECT SUBMITTALS:

- A. Furnish complete catalog data for manufactured items of equipment to be used in the Work to for review within 15 days after award of Contract.
- B. Submittal shall include, but not be limited to the following:
 - 1. equipment scheduled
 - 2. certificates of guarantee
 - 3. any item for which more than one manufacturer is mentioned
- C. Submit a minimum of five copies of data in binders and index in same order and name as they appear in Specification.
 - 1. State sizes, capacities, brand names, electrical requirements, accessories, materials, gauges, dimensions, and other pertinent information.
 - 2. List on catalog covers page numbers of submitted items.
 - 3. Underline or highlight applicable data.

- D. If material or equipment is not as specified or submittal is not complete, it will be rejected.
- E. Catalog data or shop drawings for equipment which are noted as being reviewed by Engineer shall not supercede Contract Documents.
- F. Reviewed comments shall not relieve this Division from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- G. Check work described by catalog data with Contract Documents for deviations and errors.
- H. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations and drawing layouts.
- I. The Contractor shall review the submittals prior to submission to the to make sure that the submittals are complete in all details. No submittal will be reviewed which does not bear the contractor's notation that such checking has been made.
- J. No partial submittals will be considered unless approved by the Engineer.
- K. Manufacturers' names shall be mentioned as acceptable prior to bidding.
- L. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment.
- M. Contractor shall review equipment submittals for compliance with schedules, specifications, and drawing plans and details. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as piping connections, etc.
- N. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment. Submittals shall clearly indicate name of manufacturer of each item.
- O. For unacceptable items, the right shall be reserved to require the first named specified items.
- P. Where submittals are sent to with any of the above listed information missing or are incomplete they will be returned to the contractor unchecked to be completed and resubmitted. No additional time or money shall be allowed for failure to provide complete submittals on the first review.
- Q. If an item requiring submittal review is ordered, purchased, shipped, or installed prior to the submittal review and is subsequently disapproved the item shall be removed from the job site and replaced with an approved item at contractors expense.

1.5 CLEANING & FINISHING:

- A. Contractor shall, at all times, keep the boiler plant and tunnel free from waste material and rubbish. Upon completion of this Section of the work, Contractor shall remove all surplus materials and rubbish; clean, etc.; do all required patching up and repair all work of other trades damaged by Contractor under this Section of the work, and leave the premises in a clean orderly condition. Refinish any damaged surfaces and leave in proper working order at final completion.

1.6 SUPERVISION:

- A. The Contractor shall supervise and direct the work with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

1.7 SAFETY REGULATIONS:

- A. Contractor shall provide equipment, supervision, construction, procedures, and everything necessary to assure safety of life or property.
- B. Refer also to General Condition and Special Conditions for protection clauses.

1.8 LEAK DAMAGE:

- A. Contractor shall be responsible for damages to the work of other Contractors, caused by leaks and shall make at his own expense all repairs to the satisfaction of the Owner and Engineer.

1.9 TOOLS AND STORAGE OF EQUIPMENT:

- A. The Contractor shall furnish all necessary tools, staging and whatever may be necessary for the installation of this work and shall at all times protect this work and others, and the materials to be used therein from damage by the weather, accident and other causes, and shall repair and make good any damage thus occurring.

1.10 WORKMANSHIP:

- A. Workmanship shall be the best quality of its kind for respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner and Engineer. Nothing contained herein shall relieve the Contractor from performing good work, perfect in all details of construction.

1.11 TEMPORARY FACILITIES:

- A. Furnishing of temporary water, sanitary facilities, drainage lines, light and power will be as specified in Division 01 General Conditions. Contractor shall arrange to bring facilities to required location of premises. All expenses involved shall be paid by the Contractor as described in General and Special Conditions.

1.12 PAINTING BY CONTRACTOR:

- A. See section 09900 for painting requirements. See also section 15075 for color code requirements.
- B. Painting shall be by persons experienced in painting.
- C. All exposed, equipment, metal stands and supports shall be painted as follows:
 - 1. The prime coat on equipment shall be factory applied. The finish coats shall be applied under Section 09900 of these specifications.
 - 2. All equipment which is to be furnished in finished painted condition by Contractor shall be left without mark, scratch or impairment to finish upon completion and acceptance of job. Any necessary refinishing to match original shall be done by Contractor. Do not paint over name plates, serial numbers or other identifying marks.

1.13 INSPECTION NOTICE:

- A. The following is a basic list of guideline items so that the Engineer, State inspector/Owner's representative can be at job site for these inspections as the construction progresses. Contractor shall inform these people one week in advance of test time.
 - 1. Any changes or problems occurring at job site.
 - 3. Periodic inspection at their discretion will be made to insure compliance to Contract Documents and codes. Contractor shall provide ladders, access and other assistance as requested during inspections.
 - 4. Final inspection before giving approval for final payment.

1.14 EXCAVATION AND BACKFILLING:

- A. See Division 02 for Excavation, Backfilling, Earthwork, etc.
- B. Excavation for pipe supports shall be excavated to the required depth. Rocks, trash, or other debris will not be allowed in the excavation or backfill and shall be removed before concrete is installed.

1.15 WARRANTY GUARANTEE:

- A. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.
- B. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.
- C. The one year guarantee on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial

completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)

- D. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.16 COMPLETION SCHEDULE:

- A. At the time of the final inspection a date shall be agreed upon for completion of any remaining items.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 15051

SPECIFICATION

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SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Earthwork.
 - 3. Electrical demolition.
 - 4. Cutting and patching for electrical construction.
 - 5. Touchup painting.
 - 6. Temporary Power and Communication
 - 7. Permits and Fees

1.3 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Submittal Procedures: Submittal procedures are specified in Division 1.
 - 1. Prepare submittals in three-ring "hard cover" binders with project name and volume on the binding. Include tabs identified by the specification section and in numerical order. Include plastic sleeves to hold drawings that exceed 8-1/2" x 11".
 - 2. Include cover sheet with the following information: date, project name, address, and title; Installer's name, address and phone number; Project manager, and Engineering firm names and phone numbers.
- E. Project Record Documents: Project Record Documents are specified in Division 1.
 - 1. Redline changes or information recognized to be of importance to the Owner. Include wiring changes, panelboard changes, etc.
 - 2. Dimension underground wiring and other concealed electrical features.

3. Redline actual equipment electrical characteristics on equipment schedules.
- F. Digital Operation and Maintenance Manual on CD-ROM
1. Intuitive CD-ROM instructional manual for information to care, adjust, maintain and operate equipment. Include contract documents, shop drawings, product data.
 - a. Software: Adobe Acrobat.
 - b. Format: PDF.
 - c. Index: Hypertext alphabetical index.
 - d. Auto Starting: Windows 9X with any directions to continue observable on the screen.
- G. Coordination drawings for electrical installations: When requested by the Architect/Engineer, provide the following:
1. Coordination drawings showing all electrical component locations and sizes coordinated with equipment, cabinets, and other architectural design elements.
 2. Coordination drawings showing all electrical component locations and sizes coordinated with reflected ceiling plans.
 3. Coordination drawings showing all electrical power and distribution equipment coordinated with floor plans and other equipment identifying all required clearances.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with Owner Standards.
1. State of Utah, Division of Facilities Construction and Management "Design Criteria".
 2. Southern Utah University "Design Standards"
- D. Installer Qualifications: All workmen doing electrical work shall be duly licensed with the required supervision in the State or Locality as legally required.
1. Site Review: All electricians must carry their electrician's license with them and show it upon request.

1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical equipment installation with other building components.
 1. Verify all dimensions be field measurements.
 2. Minimize costs to resolve equipment and other conflicts by successfully concluding preinstallation conferences. Include the following:
 - a. Review Division 15 shop drawings. Compare equipment electrical specifications with equipment schedule. Prevent Div 15 equipment encroaching on clearances required by NEC. Request clarification of conflicts prior to installation.
 - b. Determine whether lighting fixtures and other electrical items conflict with the location of structural members and mechanical or other equipment.
 - c. Coordinate connecting electrical service to components furnished in other sections of the specification or by the User. Verify electrical requirements including voltage, full load amps, and minimum wire ampacity prior to installing or purchasing the associated electrical equipment and wiring.
 - d. Review systems furniture electrical specifications and compare with wiring indicated. Request dimensional layout from furniture installer including electrical connection locations. Request clarification of conflicts prior to installation.
- D. Coordinate electrical service connections to components of Owner's facilities.
 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 2. Comply with requirements of authorities having jurisdiction and of Owner providing electrical power and other services.
 3. Notify Architect a minimum of seven days in advance of any proposed utility interruption and obtain approval prior to proceeding. Comply with requirements of the Owner, User, and Utility.
 4. Include all costs, including Owner, municipal or utility costs that will need to be paid to obtain electric service.
- E. Coordinate communication service connections to components of Owner's facilities.
 1. Coordinate installation and connection of exterior underground and overhead utilities and services.
 2. Comply with requirements of authorities having jurisdiction.
 3. Notify Architect a minimum of seven days in advance of any proposed utility interruption and obtain approval prior to proceeding. Comply with requirements of the Owner, User, and Utility.
 4. Include all costs, including Owner, municipal or utility costs that will need to be paid to obtain communication services.

- F. Temporary Power and Communication are specified in Division 1 Section "Construction Facilities and Temporary Controls".
 - 1. Comply with requirements for temporary electric and communication services with the proper Owner's representative.
 - 2. Comply with Article 305 of the NEC.
- G. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- H. Coordinate with Authorities Having Jurisdiction including: city, county, state, university, federal and other governmental authorities.
 - 1. Obtain all permits (including excavation permits) prior to beginning construction.
 - 2. Request inspections required by Authorities Having Jurisdiction in a timely manner and in order to comply with sequencing requirements.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.
- E. Existing Utilities: Locate and identify existing underground utilities in excavation areas or in demolition areas. Maintain services to areas outside demolition limits or excavated areas. When services must be interrupted, install temporary services for affected areas.
- F. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements indicated in the Contract Documents.
- G. Record drawings and Shop Drawings: Mark up drawings daily during construction with changes or deletions in the scope of the project.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of **200-lb (90-kg)** design load.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
 - 1. Comply with NFPA 70. In addition, install supports within 12" of couplings, fittings, and boxes, with a minimum of two supports per 10 foot length of raceway. Install supports at each change of direction. Similarly support cables in cable trays or raceways as indicated; except, provide J-hooks to support cables.
 - 2. Support suspended conduit and cables independently from all other electrical or mechanical systems by attaching directly from building structure, unless prior approval in writing has been obtained from the Architect after engineering calculations have been submitted.
 - 3. Coordinate installation of supports so as not to interfere with the removal of ceiling tiles, the service of mechanical equipment, etc.
 - 4. Install bracing parallel to trusses, beams, joists, bridging, etc.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Support parallel runs of cables together on trapeze or bracket type hangers, either vertically or horizontally.
- E. Size supports for multiple raceway and cable installations so capacity can be increased by a 25 percent minimum in the future.
- F. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- G. Install **1/4-inch- (6-mm-)** diameter or larger threaded steel hanger rods, unless otherwise indicated.

- H. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- I. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- J. Simultaneously install vertical conductor supports with conductors.
- K. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If supported directly from the building structure, attach box to framing on opposite sides of the box. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- L. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- M. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
 - 1. Install wrapped or coated RMC sleeves with 3 feet extending on each side through penetrations of foundations or concrete walls by RNC.
- N. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts. Drill holes in concrete so holes do not cut main reinforcing bars. Fill and seal holes drilled in concrete and not used.
 - a. Obtain prior approval from project structural engineer prior to drilling prestressed or post-tension concrete slabs and beams.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load. Do not support electrical equipment or conduits

with toggle bolts, moly-bolts, or screws in sheetrock or plaster. Do not support electrical equipment or conduit from tie wires.

10. Do not use wooden plugs in concrete or masonry units for fastening conduits, tubing, boxes, cabinets, etc.

O. Permanently mark multiplying factor on meter face where current transformers are used.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

B. Gypsum Board Tenting: Apply to lighting fixture or electrical equipment penetrations of fire rated floor, ceiling and wall assemblies, unless product is UL listed with integral fire rating Perform tenting as specified in appropriate Division 9 section to reestablish the original fire-resistance rating of the assembly at the penetration.

3.5 EARTHWORK

A. Excavating, filling, and grading: As specified in Division 2 Section "Earthwork."

B. Fill: Backfill for underground raceways (not concrete encased) in roadways or parking lots with concrete encased slurry (1 bag mix). Backfill underground raceway (not concrete encased with sand 6" above and below in other than roadways or parking lots.

C. Remove rubbish, waste, and excess soils.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

1. Relocate existing electrical devices, conduit or equipment that for any reason obstructs construction. Include any equipment having electrical connections that requires disconnecting and reconnection at the same or another location throughout the course of construction.

2. Maintain in working condition all electrical equipment and apparatus in areas not remodeled.

3. Temporary Partitions or Dust Barriers: Prevent the spread of dust and dirt to adjacent areas.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

1. Include exposed equipment and installations made obsolete by new work.

- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove and legally dispose of demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- F. Remove conductors from raceway to the first active outlet or branch panels for vacated or unused circuits.

3.7 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
 - 1. Core drilling: X-Ray post-tension slabs prior to core drilling to assure that post-tension cables are not damaged.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Supporting devices for electrical components.
 - 2. Electricity-metering components.
 - 3. Concrete bases.
 - 4. Electrical demolition.
 - 5. Cutting and patching for electrical construction.
 - 6. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
 - 1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
 - 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
 - 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
 5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.
- C. Test all electrical work to ensure that they test free of mechanical and electrical defects.
1. Comply with testing requirements of authorities having jurisdiction.
 2. Comply with Owner's standards for testing in documents listed in "Quality Assurance".

3.9 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
1. Remove labels that are not permanent labels.
 2. Wipe surfaces of electrical equipment. Remove excess lubrication and other substances.
 3. Clean exposed exterior and interior hard-surface finishes to a dust-free condition, free of stains, films and similar foreign substances.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 16 Section "Lightning Protection" for additional grounding and bonding materials.

1.3 SUBMITTALS

- A. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- B. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erco Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.

- e. Dossert Corp.
- f. Erico Inc.; Electrical Products Group.
- g. Framatome Connectors/Burndy Electrical.
- h. Galvan Industries, Inc.
- i. Harger Lightning Protection, Inc.
- j. Hastings Fiber Glass Products, Inc.
- k. Heary Brothers Lightning Protection Co.
- l. Ideal Industries, Inc.
- m. ILSCO.
- n. Kearney/Cooper Power Systems.
- o. Korns: C. C. Korns Co.; Division of Robroy Industries.
- p. Lightning Master Corp.
- q. Lyncole XIT Grounding.
- r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
- s. Raco, Inc.; Division of Hubbell.
- t. Robbins Lightning, Inc.
- u. Salisbury: W. H. Salisbury & Co.
- v. Superior Grounding Systems, Inc.
- w. Thomas & Betts, Electrical.
- x. VFC, Inc.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- E. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- F. Copper Bonding Conductors: As follows:
 - 1. Bonding Conductor: as noted on the drawings, stranded copper conductor. Comply with NEC minimum requirements.
 - 2. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; **1-5/8 inches (42 mm)** wide and **1/16 inch (1.5 mm)** thick.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.1 APPLICATION

- A. In raceways, use insulated equipment grounding conductors.
- B. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and branch wiring.
- C. Air-Duct Equipment Circuits: Install an equipment-grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment-grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- C. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

END OF SECTION 16060

SECTION 16071 - SEISMIC CONTROLS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

- A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.
 - 1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.
- B. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.
 - 1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - 2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
 - 3. Preapproval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints and the basis for approval (tests or calculations).

- C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in IBC, unless requirements in this Section are more stringent.
- 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 seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

1.6 PROJECT CONDITIONS

- A. Project Seismic Conditions: As indicated by Structural Engineer.

1.7 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. B-Line Systems, Inc.
 - 3. Erico, Inc.
 - 4. GS Metals Corp.
 - 5. Loos & Company, Inc.
 - 6. Mason Industries, Inc,
 - 7. Powerstrut.
 - 8. Thomas & Betts Corp.
 - 9. Unistrut Corporation.

2.2 MATERIALS

- A. Use the following materials for restraints:
 - 1. Indoor Dry Locations: Steel, zinc plated.
 - 2. Outdoors and Damp Locations: Galvanized steel.
 - 3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch (41-by-41-mm) cross section, formed from 0.1046-inch- (2.7-mm-) thick steel, with 9/16-by-7/8-inch (14-by-22-mm) slots at a maximum of 2 inches (50 mm) o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 570, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.
1. Install bracing parallel to trusses, beams, joints, bridging, etc.
- B. Install safety wires fastened to structure at diagonal corners of lighting fixtures for seismic support of fixtures mounted in or on grid type ceilings. Do not fasten to grid hangers or to grid hanger's point of support.

3.2 STRUCTURAL ATTACHMENTS

- A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
- B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
- C. Attachments to Existing Concrete: Use expansion anchors.
- D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
- E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
- F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
- G. Attachments to Wood Structural Members: Install bolts through members.
- H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
- B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, transfer switches, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

- A. Install bracing according to spacings and strengths indicated by approved analysis.
- B. Expansion and Contraction: Install to allow for thermal movement of braced components.
- C. Cable Braces: Install with maximum cable slack recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.6 FIELD QUALITY CONTROL

- A. Testing: Test pull-out resistance of seismic anchorage devices.
 1. Provide necessary test equipment required for reliable testing.
 2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 4. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
 5. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 6. Test to 90 percent of rated proof load of device.
 7. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
 8. Record test results.

END OF SECTION 16071

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).
- B. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend indicating type of underground line.
- C. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
- C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.3 kg) minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches (51 mm) high, stenciled with paint at 10-foot (3-m) intervals over a continuous, painted orange background. Identify the following:
1. Entire floor area directly above conduits running beneath and within 12 inches (305 mm) of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to conduits concealed within wall.
 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 4. Entire surface of exposed conduits.
- F. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
 2. Prime surfaces using type of primer specified for surface.
 3. Apply one intermediate and one finish coat of enamel.
- G. Paint fire alarm junction boxes red.
- H. Circuit Identification Labels on Boxes: Install labels externally for all installed boxes prior to installation of conductors.
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 2. Concealed Boxes: Plasticized card-stock tags.
 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- I. Circuit Identification Labels on Plates for Emergency Circuits: Install labels externally for all installed wiring device plates indicating panel and circuit number.
1. Clear preprinted adhesive labels.
- J. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- K. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed **16 inches (400 mm)** overall, use a single line marker. Install line marker for underground wiring, both direct buried cables and cables in raceway.
- L. Color-Coding of Secondary Phase Conductors: Color code switch legs, travelers and other wiring for branch circuits other than those listed below. Permanently post color code at each branch panelboard. Use the following colors for service, feeder and branch-circuit phase conductors:
1. 208/120-V Conductors:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 - f. Insulated Ground: Green with white stripe.
 2. 480/277-V Conductors:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Ground: Green.
 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 6 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

- M. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
1. Legend: **1/4-inch- (6.4-mm-)** steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
- N. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
 4. Identify concrete encased feeders over 600 V with red dye.
- O. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum **3/8-inch- (9-mm-)** high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
 3. Install caution signs for enclosures Over 600 V: Indicate system voltage on black, preprinted on orange field.
- P. Wall Mounted One Line Diagram: Provide a chrome framed glass enclosure for wall mounting one line diagram indicating minimum short-circuit ratings for all overcurrent protection installed in panelboards and switchboards, and recommend replacement catalog numbers for fuses and other current limiting devices for service, feeder, or mains protection.
- Q. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high lettering on **1-1/2-inch- (38-mm-)** high label; where two lines of text are required, use labels **2 inches (50 mm)** high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Interior and exterior of panelboards, electrical cabinets, and enclosures.
 - a. Distribution Panelboards: Identify Distribution Panelboard designation and circuit serving distribution panelboard; label main and distribution overcurrent protection showing load served and location (identify room numbers).
 - b. Branch Panelboards: Identify distribution panel and circuit serving panelboard.
 - c. Main Overcurrent Protection: Identify main device and service disconnects.
 2. Access doors and panels for concealed electrical items.
 3. Electrical switchboards.
 - a. Identify switchboard, label main and distribution overcurrent protection showing load served and location (identify room numbers).
 4. Emergency system boxes and enclosures.

5. Motor-control centers.
 6. Disconnect switches.
 7. Enclosed circuit breakers.
 8. Motor starters.
 9. Power transfer equipment.
 10. Contactors.
 11. Remote-controlled switches.
 12. Dimmers.
 13. Control devices.
 14. Transformers.
 15. Clock/program master equipment.
 16. Fire alarm master station or control panel.
- R. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality-Control Test Reports: by Contractor.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. Copper Wire and Cables:
 - a. American Insulated Wire Corp.; a Leviton Company.
 - b. General Cable Corporation.

- c. Senator Wire & Cable Company.
- d. Southwire Company.

- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

- C. Conductor Material: Copper, minimum size #12 for phase conductors and #14 for control conductors complying with NEMA WC 7; stranded conductor.

- D. Conductor Insulation Types: Type THWN-2 and XHHW complying with NEMA WC 7.

- E. Multiconductor Cable: Not allowed.

2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Burndy.
 - 4. Hubbell/Anderson.
 - 5. IlSCO.
 - 6. O-Z/Gedney; EGS Electrical Group LLC.
 - 7. 3M Company; Electrical Products Division.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type XHHW, single conductors in raceway.

- B. Feeders: Type THWN-2, single conductors in raceway.

- C. Branch Circuits: Type THWN-2, single conductors in raceway.

- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

- E. Fire Alarm Circuits:
 - 1. Type THWN-2 in raceway for fire alarm power circuits, for horn circuits, and for strobe circuits.
 - 2. Power-limited, fire-protective, signaling circuit cable in raceway for initiating loop circuits.

- F. Emergency circuits: Install in separate raceways from all other wiring, except where they connect to the same equipment for two-source operation.

- G. Class 1 Control Circuits: Type THWN-2, in raceway.

- H. Class 2 Control Circuits: Type THWN-2, in raceway.

- I. Fixture Conductors: Install conductors in lighting fixtures with insulation ratings as recommended by the manufacturer's written instructions or a minimum 90 degrees C., whichever is higher.
- J. Communication Conductors: Install communication conductors in raceway.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Multi-wire branch circuits: install no more than three circuits in a raceway, unless specifically shown otherwise.
- C. Install #10 conductors for branch circuits for which the conductor length from panelboard to furthest outlet is more than 100' for 120 volt or more than 140' for 277 volt circuits. Install #8 conductors in for branch circuits for which the conductor length from panelboard to furthest outlet is more than 200' for 120 volt or more than 250' for 277 volt circuits. Increase raceway size to 1" diameter for #8 conductor size
- D. Neutral Conductors for Branch Circuits: Provide a dedicated neutral conductor that is one size larger than the phase conductor for all multi-wire branch circuits that share a neutral conductor.
- E. GFI circuit breakers or feed-thru outlets to outlets served: provide separate neutrals.
- F. Panelboards, switchboards, MCCs, switchgear: Do not route conductors through a section which terminate in another section, except for interconnecting control conductors.
- G. Remove existing conductors from raceway before pulling in new wires and cables.
- H. Parallel conductors: Where parallel conductors are installed in parallel raceways, install in each raceway conductors of phase, neutral and/or ground as specified. Carefully cut parallel conductors to identical length for each phase leg. Do not parallel conductors less than #1/0.
- I. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- K. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- L. Do not install wiring through any part of a transformer vault or elevator equipment room and shaft that is does not serve equipment in the respective room. Also, coordinate that piping or other items foreign to the transformer vault, elevator equipment room or shaft is not installed in these spaces.
- M. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- N. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

- O. Identify and color-code conductors and cables according to Division 16 Section " Electrical Identification."

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Conductor splices: Minimize conductor splices. Do not install in conduit bodies.
- C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- E. Furniture connections: connect systems furniture to power supply circuits per manufacturer's written instructions.
- F. Panelboard connections: do not splice conductors in panelboards.
- G. Service Connections: Provide lugs, cable, and all other materials necessary to complete connections to the transformer or service lateral for the building.
 - 1. Measure voltage at main disconnect and adjust taps if necessary to obtain the proper value.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
 - 3. Division 16 Section "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
 - 4. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Manufacturer:
 - 1. AFC Cable Systems, Inc.
 - 2. Alfex Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 6. LTV Steel Tubular Products Company.
 - 7. Manhattan/CDT/Cole-Flex.
 - 8. O-Z Gedney; Unit of General Signal.
 - 9. Wheatland Tube Co.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Steel Set-screw or compression type. Do not use die-cast fittings.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings: NEMA FB 1; compatible with conduit and tubing materials. Do not use die-cast fittings.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturer:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Manufacturer:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R as required by location.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard color as selected by the Architect.

1. Manufacturer:
 - a. Thomas & Betts Corporation.
 - b. Monosystems.
 - c. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Sheet metal, fully adjustable, rectangular.

E. Floor Boxes: Nonmetallic, nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 EXPANSION FITTINGS:

A. Manufacturer:

1. O-Z Gedney; Unit of General Signal.

B. Expansion Fittings: Malleable Iron, hot dipped galvanized, weatherproof suitable for raceway and applications

1. Coordinate expansion requirements with Architect.

2.8 FACTORY FINISHES

- A. Finish: provide manufacturer's standard paint applied before shipping to factory-assembled products for:
 - 1. Surface raceways: Color as selected by Architect.
 - 2. Enclosures: Standard Grey in electrical rooms, white in finished areas.
 - 3. Cabinets: Standard Grey in electrical rooms, white in finished areas.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC (except coated or wrapped rigid steel for bends greater than 22 degrees), coated or wrapped rigid steel.
 - 4. Underground, Grouped: RNC (except coated or wrapped rigid steel for bends greater than 22 degrees), coated or wrapped rigid steel.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R.
- B. Indoors:
 - 1. Exposed:
 - a. Above 6' from finished floor: EMT or Rigid Steel.
 - b. Below 6' from finished floor, or subject to mechanical damage: Rigid Steel.
 - 2. Underground: refer to underground installation selections in outdoor paragraph above.
 - 3. Concealed: EMT, or Rigid Steel.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Damp or Wet Locations: Rigid steel conduit.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Minimum Raceway Size:
 - 1. Metallic Conduits: 3/4-inch trade size (DN 21) except 1/2" C trade size (DN 16) for low voltage automatic temperature control or motor control wiring.
 - 2. Nonmetallic Conduits: 3/4-inch trade size (DN 21).
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Metal Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated. Engage a minimum of five full threads.
 - 2. PVC Externally Coated or wrapped Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
 - 3. EMT: set screw or compression for dry interior locations; compression for damp or wet locations; compression with tape for installations in concrete slabs above grade.
 - 4. Building Expansion joints: use expansion fittings with 36" of wrapped metal raceways on either side of joint.

3.2 INSTALLATION

- A. Layout of electrical boxes: Do not scale electrical drawings.
1. Coordinate with architectural elevations. Where outlets are not identified on the elevations, refer mounting height decisions to the Architect. If counters or work surfaces are shown refer mounting height decisions, whether above or below counter, to the Architect. Coordinate location of switches with actual door swings.
 2. Verify final locations with field measurements and with the requirements of the actual equipment to be connected as determined from shop drawings.
 3. Refer to mounting height detail sheet for typical elevations.
 4. Mounting heights indicated in the symbol schedules are to the center of the outlet.
 5. Mounting heights indicated on the drawings for wall mounted lighting fixtures are to the center of the lighting fixture.
 6. Mounting heights indicated on the drawings for pendant mounted lighting fixtures are to the bottom of the lighting fixture.
 7. Mechanical and equipment rooms. Coordinate location of lighting and power outlets with duct and equipment locations. Do not install outlets behind equipment or where otherwise inaccessible. Position lighting, regardless of where shown on drawings, to provide proper illumination.
 8. Mount outlet boxes for switches and receptacles with the long axis of the device vertical unless otherwise indicated.
 9. Set boxes with plaster-rings flush with finished surface.
 10. Install boxes on opposite sides of wall with a stud and a minimum 10" between them.
 11. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally.
- B. Outlet Boxes:
1. Frame construction: 4"X4"X1-1/2" with suitable plaster-ring, except:
 - a. 2-1/8" deep for boxes with 3 conduit entrances or for communication outlets
 - b. 4-11/16" boxes for boxes with 4 or more conduits.
 2. Masonary or concrete construction: 1g or multiple gang by 3-1/2" deep.
 3. Fixture Outlets: minimum 4" outlet box with 3/8" fixture stud supported adequately for minimum of 200 lbs.
 4. Do not use gangable boxes.
- C. Keep raceways at least **12 inches (300 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- F. Install temporary closures to prevent foreign matter from entering raceways.
- G. Stub-ups: Embed coupling flush with finished floor. If to remain a spare, the flush plug is to remain in the coupling.
- H. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated. Make bends in parallel or banked runs from same centerline to make bends parallel.
1. Nonmetallic Conduits: Use rigid elbows for all bends 22 degrees or greater.

2. Communication Systems Raceways: comply with long sweep radius elbows minimum dimensions in Table 5.2-1 of ANSI/TIA/EIA-569A for all bends or offsets for backbone cables.
- I. Raceways below grade: Install RNC or wrapped/coated Rigid Steel minimum 24" below grade, unless specifically noted otherwise. Where noted encase in concrete.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors, except at surface mounted panels and apparatus or unless otherwise indicated. Install surface raceways only where indicated or where directed by Architect.
 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
 2. Install surface raceways in rooms where surface mounted panels are indicated or for exposed equipment in mechanical, electrical, or communication rooms.
- K. Raceways in Elevated Slabs: Do not embed raceways in elevated slabs.
- L. Raceways Embedded in Slabs on Grade: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
 1. Maximum conduit size: Lesser of 1-inch trade size (DN 27) or 1/3 the concrete cover.
 - a. For conduits larger than 1-inch trade size (DN 27), consult structural engineer for additional structural supports or other options.
 2. Layout: Route conduits without crossovers. Space conduit at least 18" apart. Space raceways laterally to prevent voids in concrete.
 - a. Where concentrations of conduit occur, support slab independent of steel deck. Coordinate with structural engineer.
 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 4. Install taped compression type fittings or fittings approved for such use.
 5. When using PVC for slabs on grade, change from nonmetallic tubing to rigid steel conduit before rising above the floor.
- M. Raceways Penetrating foundation walls: Install rigid conduit through the foundation wall or 3' each side.
- N. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 1. Run parallel or banked raceways together on common supports.
 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- O. Raceway coordination: Do not install raceways in or through the following areas that do not serve equipment in those areas:
 1. Elevator equipment rooms.
 2. Electrical vaults.
- P. Join raceways with fittings designed and approved for that purpose and make joints tight.
 1. Use insulating bushings to protect conductors.

- Q. Tighten set screws of threadless fittings with suitable tools.
- R. Cap open ends of empty conduit to keep out debris until the project is completed.
- S. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. For RMC and IMC, use two locknuts, one inside and one outside box and a bushing. For EMT, use insulated throats or plastic bushings (except for grounding bushings where required).
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
 - 3. Service Conduits or conduits installed in concentric/eccentric knock-outs or reducing washers: terminate raceway with grounding bushings.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Plug empty raceways at both ends.
- U. Low Voltage, Telephone, and Signal System Raceways, **2-Inch Trade Size (DN 53)** and Smaller: In addition to above requirements, install raceways in maximum lengths of **150 feet (45 m)** and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- V. Install seals for conduit penetrations of slabs on grade and exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- W. Roof Penetrations: Install flashings for conduit penetrations of roofs under the direct supervision of the roofing installer.
- X. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where conduits pass through airtight spaces or plenums to prevent air leakage.
 - 3. Where conduits pass from hazardous areas to nonhazardous.
 - 4. Where otherwise required by NFPA 70.
- Y. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used **6 inches (150 mm)** above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- Z. Raceway Cleaning: Prevent accumulation of water, dirt or concrete in raceways. Where water or foreign matter have entered raceways, thoroughly clean or replace conduits where such accumulation cannot be removed by methods approved by this Engineer.
- AA. Flexible Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or

movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

- BB. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- CC. Set floor boxes level and flush with finished floor surface.
- DD. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- EE. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles, ground-fault circuit interrupters, and isolated-ground receptacles.
 - 2. Single- and double-pole snap switches and dimmer switches.
 - 3. Device wall plates.
 - 4. Special purpose receptacles.
 - 5. Pin and sleeve connectors and receptacles.
 - 6. Floor service outlets, poke-through assemblies, and multioutlet assemblies.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. PVC: Polyvinyl chloride.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Leviton Mfg. Company Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.
 - 2. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).
 - 3. Poke-Through, Floor Service Outlets:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Square D/Groupe Schneider NA.
 - d. Thomas & Betts Corporation.
 - e. Wiremold Company (The).
 - 4. Dimming Switches:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Lighting Controls
 - c. Lightolier Controls
 - d. Lutron Electronics, Inc.

2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
 - 1. Thermoplastic face.
 - 2. Thermoset base.
 - 3. Back and side wired.
 - 4. Rating: 20 A minimum

- B. Straight-Blade (30 A thru 50A) and Locking Receptacles: Heavy -Duty grade.
- C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
- D. Isolated-Ground Straight-Blade Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498; configure with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
 - 1. Devices: Listed and labeled as isolated-ground receptacles.
 - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
 - 3. Thermoplastic face.
 - 4. Thermoset base.
 - 5. Back and side wired.
 - 6. Rating: 20 A minimum
- E. Isolated-Ground Receptacles: Straight blade or locking to match equipment, Heavy-Duty grade, single receptacle, with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
 - 1. Devices: Listed and labeled as isolated-ground receptacles.
 - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- F. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.

2.3 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle mounted at ceiling with external cable grip and spring tension device attached to SO Cord with duplex receptacle in nylon body as indicated in referenced detail.
 - 1. Matching, locking-type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty.
 - 2. Straight-Blade Duplex receptacle (refer to previous specification) in Nylon body.
 - 3. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 4. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
 1. Rating: Minimum 20A.
 2. Thermoplastic face.
 3. Thermoset base.
 4. Back and side wired.
 5. Pilot Light as referenced on the drawings.
- B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 1. Control: Continuously adjustable vertical slider; with single-pole or three-way switching to suit connections.
 2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz, continuously; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and **5-inch (130-mm)** wire connecting leads.
 3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 1 percent of full brightness.
 4. Magnetic Low-Voltage Lamp Dimmers: Modular, 120 V or 277 V, 60 Hz, continuously adjustable; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; DC protection; and **5-inch (130-mm)** wire connecting leads.
 5. Electronic Low-Voltage Lamp Dimmers: Modular, 120 V or 277 V, 60 Hz, continuously adjustable; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; DC protection; and **5-inch (130-mm)** wire connecting leads. Exclusively designed product for electronic low voltage transformers.

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish, except screwless devices for locations where only dimmers are shown.
 2. Material for Finished Spaces: **0.035-inch- (1-mm-)** thick, satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.7 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type or flap-type, single-service, dual-service, and three-service units suitable for wiring method used as noted in attached schedule.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish with suitable flange for finished floor.

- D. Power Receptacle: NEMA WD 6, DSCC Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Coordinate cover with voice/data installer.

2.8 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 - 1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
 - 2. Size: Selected to fit nominal 3-inch (75-mm) cored holes in floor and matched to floor thickness.
 - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 4. Closure Plug: Arranged to close unused 3-inch (75-mm) cored openings and reestablish fire rating of floor.
 - 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.9 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.

2.10 FINISHES

- A. Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Install wall dimmers with capacity to achieve 60% of circuit loads indicated on drawings after derating for ganging according to manufacturer's written instructions.
- C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

- D. Install control wiring for electronic fluorescent dimmers (low voltage or line voltage) per manufacturers written instructions.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- F. Wallplates and coverplates: install wallplates and coverplates for all outlets, including blank outlets.
- G. GFI Devices: Install separate GFCI devices, except where installed under the same multi-gang plate.
- H. Remove wall plates and protect devices and assemblies during painting.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. Install cord and plug sets for appliances, mechanical equipment, and other equipment per manufacturer's written instructions.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section " Electrical Identification."
 - 1. Receptacles on Emergency Power: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with color-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
 - a. Black letters on light colored plates.
 - b. White on dark colored plates.

3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16140

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
 - 3. Transient voltage surge suppressor panelboards.
- B. Related Sections include the following:
 - 1. Division 16 Section "Fuses."
 - 2. Division 16 Section "Seismic Controls for Electrical Work."
 - 3. Division 16 Section "Transient Voltage Surge Suppression."

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.
- D. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Layout of overcurrent devices in panelboard.
 - e. UL listing for series rating of installed devices.

- f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

- A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets as indicated on the drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
- B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus: Hard-drawn copper, 98 percent conductivity.
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- H. Insulated Equipment Ground Bus: Adequate for feeder and branch-circuit equipment insulated ground conductors; insulate from box.
- I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

- K. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Hinged front cover with concealed hinges; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: as indicated on drawings.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 3. Fused switches.

2.6 TVSS PANELBOARDS

- A. Refer to Division 16 "Transient Voltage Surge Suppression."

2.7 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.

- d. Ground-fault pickup level, time delay, and I2t response.
- 4. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Examine areas where panelboards are planned to be installed. Coordinate with other installers so that installation complies with NEC 110-26.
 - 1. Do not locate panelboards so that the door swing swings through the clear area.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."
- C. Mounting Heights: Top of trim **74 inches (1880 mm)** above finished floor, unless otherwise indicated.
- D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Circuit Directory: Create a directory to indicate installed circuit loads showing locations (final room numbers as determined by user) and use. Obtain approval for room numbers to be used before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
 - 1. Existing Panelboards: verify existing circuits and create new circuit directory.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub six **1-inch (27-GRC)** empty conduits from panelboard section into accessible ceiling space or space designated to be ceiling space

in the future. Stub five 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- C. Phase Conductor Color Code Identification: Permanently post at each branch-circuit panelboard the color coding scheme for phase conductors of all voltages used in the project.

3.4 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures with lamps and ballasts.
 - 2. Lighting fixtures mounted on exterior building surfaces.
 - 3. Emergency lighting units.
 - 4. Exit signs.
- B. Related Sections include the following:
 - 1. Division 16 Section "Lighting Controls" for manual or programmable control systems employing low-voltage control wiring or data communication circuits.
 - 2. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
 - 3. Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 4. Division 16 Section "Dimming Controls" for architectural dimming systems.

1.3 DEFINITIONS

- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
 - 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
 2. Emergency lighting unit battery and charger.
 3. Fluorescent and high-intensity-discharge ballasts.
 4. Lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Samples for Verification, When Requested: For interior lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.
1. Lamps: Specified units installed.
 2. Ballast: 120-V models of specified ballast types.
 3. Accessories: Cords and plugs.
- E. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
- F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.
- G. Warranties: Special warranties specified in this Section.
- H. Spare Parts: include spare parts materials and quantity.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1. Test products to UL standards by nationally recognized testing laboratory, where an appropriate standard exists.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
 - 2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FIXTURES AND COMPONENTS, GENERAL

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
 - 1. Equip recessed fixtures with six foot flexible conduit whips for connection to external j-boxes, except that junction boxes may be integral for prewired framing kits for incandescent and PL fluorescent downlights.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.

- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 92 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is scheduled.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LIGHTING FIXTURES

- A. Fixtures: Refer to Lighting Fixture Schedule on the drawings.

2.4 FLUORESCENT LAMP BALLASTS

- A. Description: Include the following features, unless otherwise indicated:
 - 1. Designed for type and quantity of lamps indicated at full light output, unless 1.2 BF is specified.
 - a. Linear Electronic Ballasts: full light output is defined as .88 BF.
 - b. Linear Magnetic Ballasts: full light output is defined as .95 BF.
 - c. Compact Fluorescent Ballasts: full light output is defined as 1.0 BF.
 - 2. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
- B. Electronic ballasts (nondimming) for linear lamps shall include the following features, unless otherwise indicated:
 - 1. Comply with NEMA C82.11.
 - 2. Ballast Type: Programmed start with two-step lamp starting to extend life of frequently started lamps; if not available from any manufacturer, provide rapid start.
 - 3. Sound Rating: A.
 - 4. Total harmonic distortion rating of less than 20 percent according to NEMA C82.11.
 - 5. Transient Voltage Protection: IEEE C62.41, Category A.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: Less than 1.7.
 - 8. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.

9. Manufacturers: Provide products in conformance with the requirements of the contract documents manufactured by one of the following.
 - a. Universal Lighting Technologies
 - b. Advance Transformer CO.
 - c. Osram/Sylvania
 - d. General Electric Co.

- C. Ballasts for compact fluorescent lamps shall have the following features, unless otherwise indicated:
 1. Type: Electronic. Ballasts for all lamps larger than 26 watts shall be program start.
 2. Power Factor: 90 percent, minimum.
 3. Flicker: Less than 5 percent.
 4. Lamp Current Crest Factor: Less than 1.7.
 5. Electronic Ballast Operating Frequency: 20 kHz or higher.
 6. Lamp end-of-life detection and shutdown circuit.
 7. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
 8. Manufacturers: Provide products in conformance with the requirements of the contract documents manufactured by one of the following.
 - a. Universal Lighting Technologies
 - b. Advance Transformer CO.
 - c. Osram/Sylvania

- D. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:
 1. Dimming Range: 100 to 5 percent of rated lamp lumens, unless specifically indicated otherwise.
 2. Ballast Input Watts: Can be reduced from 100 to 20 percent of normal as it dims.
 3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.
 4. Manufacturers: Provide products in conformance with the requirements of the contract documents manufactured by one of the following.
 - a. Universal Lighting Technologies
 - b. Advance Transformer CO.
 - c. Osram/Sylvania
 - d. Lutron Electronics
 - e. Lightolier

- E. Ballasts for Low-Temperature Environments:
 1. Temperatures 0 deg F (Minus 17 deg C) and Higher: Electronic or electromagnetic type rated for 0 deg F (Minus 17 deg C) starting temperature.
 2. Temperatures Minus 20 deg F (Minus 29 deg C) and Higher: Electromagnetic type designed for use with high-output lamps.
 3. Manufacturers: Provide products in conformance with the requirements of the contract documents manufactured by one of the following.
 - a. Universal Lighting Technologies
 - b. Advance Transformer CO.
 - c. Osram/Sylvania.

2.5 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure (TCLP) test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

- B. T8 rapid-start low-mercury lamps, CRI of 82 (minimum), color temperature as indicated, and average rated life of 30,000 hours, unless otherwise indicated.
- C. T5 programmed-start low-mercury lamps, CRI of 85 (minimum), color temperature as indicated, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature as indicated, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
- E. Manufacturers: Provide products in conformance with the requirements of the contract documents manufactured by one of the following.
 - a. General Electric Company
 - b. Philips Lighting
 - c. Osram/Sylvania
 - d. Ushio

2.6 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: **1/2-inch (13-mm)** steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage (2.68 mm).
- D. Rod Hangers: **3/16-inch- (5-mm-)** minimum diameter, cadmium-plated, threaded steel rod.
- E. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.7 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

2.8 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.
- B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Adjust trims for recessed fixtures to eliminate light leaks. Install lamps in each fixture.
 - 1. Install fixtures with the separation from combustible material as required by lighting fixture rating, per manufacturer's written instructions; in no case, install recessed fixture within ½" of combustible material.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel or at the intersection of four tiles, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Industrial Fixtures, Continuous Rows: Use chain.
 - 4. Extruded fixtures, Continuous Rows: Suspend from cable.
- D. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
 - 1. Clean transparent materials. Replace chipped or broken lenses and other damaged transparent materials.
 - 2. Restore reflective surfaces to their reflective conditions.
 - 3. Clean light fixtures and lamps.
- B. Verify normal operation of each fixture after installation.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 16511

SECTION 16521 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts, but not mounted on exterior surfaces of buildings.
- B. Related Sections include the following:
 - 1. Division 16 Section "Lighting Poles and Standards" for poles and other support structures and for requirements of resistance to wind and ice loads.
 - 2. Division 16 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
 - 2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories, and installation and construction details.
 - 3. Luminaire materials.
 - 4. Fluorescent and high-intensity-discharge ballasts.
 - 5. Fluorescent and high-intensity-discharge lamps.
 - 6. Electrical and energy-efficiency data for ballasts.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For luminaires to include in maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate exterior luminaires with mounting and wind load requirements in Division 16 Section "Lighting Poles and Standards."

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - a. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - b. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 2. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 EXTERIOR LUMINAIRES

- A. Luminaires: Refer to Fixture Schedule.

2.3 LUMINAIRES, GENERAL

- A. Complying with UL 1598 and listed for installation in wet locations.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.4 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:
 1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: **Minus 22 deg F (Minus 30 deg C)** for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: **104 deg F (40 deg C)**.
 4. Open-circuit operation will not reduce average life.

5. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.5 HIGH-INTENSITY-DISCHARGE LAMPS

- A. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum), and color temperature 4000.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match process and color of pole or support materials specified in Division 16 Section "Lighting Poles and Standards."
- B. Factory-Painted Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Interior Surfaces: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's full range.

- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: As selected by Architect from manufacturer's full range.

2.7 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test luminaires with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.
- B. Factory test fixtures with ballasts and lamps; certify results for isofootcandle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in each fixture.
- B. Luminaire Attachment: Fasten to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
 - 1. Clean Light fixtures and lamps.
 - 2. Restore reflective surfaces to their reflective conditions.
 - 3. Clean transparent materials. Replace chipped or broken lenses and other damaged transparent materials.

END OF SECTION 16521