LARAMIE COUNTY COMMUNITY COLLEGE

PHYSICAL PLANT MCC REPLACEMENT

FOR

Laramie County Community College (LCCC)
1400 East College Drive
Cheyenne, WY 82007

ENGINEERS

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Cheyenne, WY 82001

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including the General Conditions of the Contract for Construction, General and Supplementary Conditions, and Division 01 specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Where contradictions occur between this section and Division 01, the more stringent requirement shall apply.

C. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY:

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in other sections of Division 01 through 50, and Owner (LCCC) Construction Requirements.

1.3 ELECTRICAL INSTALLATIONS:

A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements and the installation shall be worked out during construction.

C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, clarify uncertainties with the Engineer prior to quotation.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.

2. Clarification methods: At the time of bidding, bidders shall familiarize themselves with the drawings and specifications. Any questions, misunderstandings, conflicts, deletions, discontinued products, catalog number discrepancies, discrepancies between the equipment supplied and the intent or function of the equipment, etc., shall be submitted to the Engineer in writing for clarification prior to issuance of the final addendum and bidding of the project. Where discrepancies or multiple interpretations occur, the most stringent (which is generally recognized as the most costly) that meets the intent of the documents shall be enforced.
D. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.

E. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.

F. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

G. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.

H. Verify all dimensions by field measurements.

I. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.

J. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.

K. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.

L. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting and removal with minimum of interference with other installations.

M. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.

N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, motor control centers, and transformers.

1.4 COORDINATION:

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material necessary to overcome congested conditions at no increase in contract sum. The Contractor’s base bid shall include any and all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.
B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Refer to individual sections for requirements.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
2. Prepare and submit required coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale, large enough to indicate required detail, and showing the necessary dimensions. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents.
4. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work.
5. Clearly indicate solutions to space problems. Identification of space problems without solutions is not acceptable.
6. CADD Drawings: Electronic AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring CADD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.
7. Cator, Ruma, and Associates will not release any shop drawings or product submittals until a coordination drawing, meeting the requirements within these specifications, has been submitted and approved for every area of construction indicated on the Electrical plans. Start of work constitutes a material requirement for the aforementioned Coordination Drawings. Contractor shall bear any and all costs associated with changes that are not specifically addressed on the Coordination Drawings that were reviewed by the Engineer of Record.

D. Existing Conditions:

1. Contractor shall carefully survey existing conditions prior to bidding work.
2. Provide proper coordination of electrical work with existing conditions.
3. Contractor shall report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials. Start of work indicates acceptance of conditions.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

B. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attention to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

A. The construction of this project requires the Contractor to include the detailing and design of select systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers’ contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
   1. Temporary Facilities
   2. Equipment supports, hangers, anchors and seismic systems

1.7 PROJECT CONDITIONS:

A. The contractor shall attend a pre-bid walk-thru, and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work required to overcome existing conditions.

B. Provide field verification of all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Engineer, due to imperfect material or workmanship and not due to the Owner’s carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections.

G. Provide temporary electrical connections where required to maintain existing areas operable.

H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.

I. Minimize disruptions to operation of electrical systems in occupied areas.

J. After entering into contract, Contractor will be held to complete all work necessary to meet the intent of the engineered system shown on the Construction Documents and defined within these specification requirements without additional expense to the Owner.

1.8 SAFETY:

A. Refer to Laramie County Community College (LCCC) General Construction Requirements.
1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:
   A. Refer to Laramie County Community College (LCCC) General Construction Requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:
   A. Refer to Laramie County Community College (LCCC) General Construction Requirements.
   
   B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA and I ETA.
   
   C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
   
   D. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state and local regulations.
   
   E. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.
   
   F. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.

1.11 PERMITS AND FEES:
   A. Refer to Laramie County Community College (LCCC) General Construction Requirements.
   
   B. Contractor shall arrange for and pay for all permits, inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS:
   A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
   
   B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.
      1. Where any conflicts arise the more stringent requirements shall be applicable.
      2. The design of the seismic requirements shall be the responsibility of the contractor.

1.13 TEMPORARY FACILITIES:
   A. Refer to Laramie County Community College (LCCC) General Construction Requirements.
   
   B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.
C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS:

A. Refer to Laramie County Community College (LCCC) Instruction to Bidders and General Construction Requirements.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. Substituted equipment will only be allowed where specifically listed in a written addendum. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor’s responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Materials and equipment of equivalent quality may be submitted for substituted prior to bidding. This may be done by submitting to the Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall be allowed only upon the written approval of the Engineer. NO EXCEPTIONS.
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications or which does not have prior approval.

1.15 SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), and Laramie County Community College (LCCC) General Construction Requirements.
2. Contractor shall provide a submittal schedule appropriate for the size and duration of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
3. The Contractor shall identify any “long lead time” items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall have a cover page that identifies the specification section number, job name, Owner’s project number, date, Prime Contractor and Subcontractor’s names, addresses, and contact information, etc.
5. Each Specification Section shall be submitted individually and shall adequate annotation to indicate the equipment/materials/etc. within the section. Submittals with incomplete information will not be reviewed and will be sent back to be corrected.
6. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
7. An index shall be provided which includes:
   a. Product
   b. Specification Section
   c. Manufacturer and Model Number
8. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawing key notes are the basis of design and are provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor. Product names used in construction details are not necessarily considered to be basis of design and specific operating parameters should be confirmed with manufacturer prior to submitting a bid.

C. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Engineer. Any submittal not stamped or incomplete will be sent back. Data submitted directly to the Engineer from subcontractors and material suppliers will not be processed unless written, prior approval is obtained by the Contractor.

D. Submittal Review Process: Before starting work, prepare and submit to the Engineer shop drawings and descriptive product data required for the project. Continue to submit in the stated format after each Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Submittals shall be prepared per the requirements listed in each Division 26 Section.

E. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, etc.
2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

F. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

G. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

H. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

I. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&M's are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants.
J. The contractor shall cloud all changes made on submittals that are marked “Revise and Resubmit.”

K. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.

L. Mark submittals with designations as shown on the drawings and identify as required by Specification Sections. Identification shall contain the information as required in details and each label shall be submitted in list form for each: disconnect, MCC, panelboard, switchboard, overcurrent protection devices and utilization device.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:

1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Engineer of Record.
2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (lighting, wiring devices, switchgear, panelboards, protective devices, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, steel bar stock, welding rods, solder, fasteners, etc.; except as otherwise indicated.

B. Schedule of Values

1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:
   a. General Construction (total)
   b. Mobilization/Demobilization
   c. Demolition
   d. Power Distribution
   e. Basic Materials/Devices/Equipment Connections
   f. Testing, Acceptance, and Commissioning
2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy to indicate which of the variations is to be provided. Improperly marked sheets will be rejected and returned.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.

D. Shop Drawings:

1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
E. Coordination Drawings: See applicable paragraph in this specification section.

F. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

G. Operation and Maintenance Data: See applicable paragraph in this specification section.

H. Equipment Settings Report: Submit report indicating final configurations and settings.

1. Provide report of settings, parameters, programming inputs and parameters, etc., installed for each MCC bucket. The report shall be arranged by specification section and each piece of equipment broken out individually or by listing of equipment if the same settings are installed in multiple pieces of equipment.
2. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.

I. Record Drawings: See applicable paragraph in this specification section.

1.17 DELIVERY, STORAGE AND HANDLING:

A. Refer to the Division 01, Sections on Transportation and Handling and Storage and Protection.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.

E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.18 DEMOLITION/REMODEL WORK:

A. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, conduits, boxes, and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Engineer. At the completion of the remodeling works or when directed by the Engineer, all stored items not reused or wanted by the Owner shall be removed from the premises.

B. The project involves renovation and remodel of the existing building. On the drawings, work may be denoted by showing items as bold or light line weight. These annotations and terms are amplified as follows:
1. Bold Print (when used): Work included in this contract is denoted in bold print or darker line weight.

2. Light Print (when used): Work shown lightly indicates existing conditions to remain.

3. “TO BE DEMOLISHED” [R]: Contractor shall remove the existing item and the associated existing wiring. Where the raceway serving the equipment is accessible (via removal of suspended ceiling, crawl space, etc.) the raceway shall also be removed. Where the removal of a raceway leaves visible evidence on an existing surface which is not being repaired or replaced by the General Contractor, this contractor shall repair the surface. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover-plate installed. Where the concealed raceway is uncovered by demolition performed by the General Contractor, the raceway shall be removed (or extended to new location if appropriate).

4. “TO BE RELOCATED” [RL]: Existing item to be relocated. Contractor shall remove the existing item, and store in a safe place. The existing item shall be relocated to the new position as called for on the drawings. At Contractor's option, the existing wiring may be extended, or new wiring may be run from the source.

5. “TO BE REPLACED” [ER]: Existing item to be removed and new device installed in same location to facilitate new work, maintain circuit continuity.

6. “TO REMAIN” [E]: Existing item to be removed and reinstalled only as required to facilitate new work. Necessity to relocate shall be determined by Contractor during field investigations, prior to submitting bid.

C. Existing equipment that is removed and not scheduled to be reused shall remain the property of the Owner and be delivered for disposition unless specifically indicated otherwise and shall be stored in a location designated by the Owner. Items which are removed and not wanted by the Owner shall become the property of the Contractor and shall be removed from the site.

D. Existing equipment that is removed and is to be reused shall be cleaned, serviced and operable before being reinstalled.

E. Revise panelboard schedules to reflect removal or relocation of equipment. Circuit integrity of equipment in adjacent areas shall be left intact.

F. Where remodeling interferes with existing circuits and equipment which are not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the project.

G. The Contractor shall remove all distribution equipment, conductors, etc., which are indicated to be removed or which must be removed to accommodate demolition. Equipment to be removed may require reworking conduit and wiring in order to maintain service to other equipment.

H. Where remodeling interferes with circuits serving areas outside of the project or phase limits or which are remodeled in later phases of the project, circuits shall be reworked or temporary circuits provided as required. Take care to avoid overloading any one of the three phases in existing three phase panels.

I. Existing equipment and circuiting shown are based on field surveys and/or Owner furnished drawings. The Contractor shall verify conditions as they exist with necessary adjustments being made to the drawing information.

J. Coordinate the routing of all conduits with the existing mechanical and plumbing systems in order to avoid conflicts with ducts, pipes, etc.

K. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated on the drawings or allowed under the appropriate section of the specifications.
L. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken. Hazardous material removed is not a part of the work to be done under this Division.

1.19 CUTTING AND PATCHING:

A. This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

C. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

D. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

E. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new Work.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.

1.20 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for final installation requirements on physical dimensions and utility rough-in.

C. Work through all coordination before rough-in begins. See applicable Article above.

1.21 ACCESSIBILITY:

A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to ensure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts that require replacement or servicing.

B. Extend all conduits so that junction and pull boxes are in accessible locations.
C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.

1.22 TESTING:

A. Submit test reports as outlined in Quality Control for each Division 26 Section.

B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.

C. General Scope:

1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.

2. The tests and operational checks shall determine the suitability for energization.

3. Schedule tests and give a minimum of two weeks advance notice to the Engineer. Reschedule testing for Owner convenience if required.

D. Test Report: Submit electronic copy copies of the completed report to the Engineer no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).

E. Failure to Meet Test:

1. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.

F. The Contractor or testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with manufacturer recommendations. Dated calibration labels shall be visible on all test equipment.

1.23 NAMEPLATE DATA:

A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.

1.24 CLEANING:

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous
materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

1.25 RECORD DOCUMENTS:

A. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

B. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices, and any other relevant deviations from the Contract Documents.

C. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

D. Schedules:
   1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
   2. Mark schedules on drawings to indicate installed equipment and materials used, and any deviations and final revisions to electrical load data and calculations.

E. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.
   1. Red shall indicate new items, deviations and routing.
   2. Green shall indicate items removed or deleted.
   3. Blue shall be used for relevant notes and descriptions.

F. At the completion of the project, provide to the Engineer, a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the proper channels. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents for review. This contract will not be considered completed until these record documents have been received and accepted.

G. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.

1.26 OPERATION AND MAINTENANCE DATA:

A. No later than four (4) weeks prior to the completion of the project provide complete set of operating and maintenance manuals. Operation and Maintenance Data shall be submitted in electronic format.

B. Operation and Maintenance Data: Submit operation and maintenance data in maintenance manual in accordance with requirements of applicable Division 26 Section. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include all information required below, as indicated in each Division 26, and the following for each piece of equipment:
1. The job name and address, contractor’s name, address, and phone number shall be identified at the front of the electronic submittal.
2. Name, address and telephone number to be contacted of the local authorized service organization/company and individual to be contacted for service and maintenance for each item of equipment.
3. Submit operation and maintenance data, schedule of recommended service and parts lists for all materials and products specified and intended for installation. Include description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
4. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions.
5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
6. Servicing instructions charts and schedules.
7. Manufacturer's service manuals for all electrical equipment provided under this contract.
8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
9. Equipment identification numbers and adjustment clearly indicated for each piece of equipment.
11. Provide bookmarked manuals divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents. Bookmarks shall be 3M tabs for hardcopies or electronic bookmarks for pdf.
12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.

C. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical change order costs included and identified is provided and the manual is reviewed by the Engineer.

1.27 PROJECT CLOSEOUT LIST:

A. Substantial Completion

1. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   a. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   b. Advise Owner of pending insurance changeover requirements.
   c. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   d. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   e. Prepare and submit Project Record Documents, operation and maintenance manuals and similar final record information.
   f. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   g. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   h. Complete startup testing of systems.
i. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

j. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

k. Complete final cleaning requirements, including touchup painting.

l. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

2. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

   a. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

   b. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion

1. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

   a. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."

   b. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

   c. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

   d. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

2. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

C. Punchlist

1. Preparation: Submit electronic copy of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

D. In addition to the requirements specified in Division 01, complete the requirements listed below.

E. The contractor shall be responsible for providing the items listed on the Electrical Submittal Checklist prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements.
1.28 WARRANTIES:

A. General: Refer to individual equipment specifications for warranty requirements. In no case shall the warranty for the total electrical system be less than one year from date of acceptance by the Owner.

B. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

C. Organize warranty documents, specified in Division 26, into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

E. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.29 CONSTRUCTION REQUIREMENTS:

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
   1. Up to date record drawings
   2. Submittals
   3. Site observation reports with current status of all action items.
   4. Test results; including recorded values, procedures, and other findings
   5. Outage information

END OF SECTION 26 05 00
PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.

C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

C. Field Quality Control Test Reports: Submit record of testing. Refer to Section 26 05 00 – Common Work Results for additional requirements.

D. Record Documents: Record actual installed circuiting arrangements for panel feeders and underground circuits.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.
PART 2 - PRODUCTS

2.1 APPLICATIONS

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed. Wire shall be single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

B. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. Circuits shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit will not be permitted for this project.
   2. Copper conductors ONLY.

C. Dry and Concealed Interior Locations
   1. Provide single conductor building wire in suitable raceway system.

D. Dry and Exposed Interior Locations
   1. Provide single conductor building wire in suitable raceway system.

E. Damp or Wet Interior Locations
   1. Provide single conductor building wire in suitable raceway system.

F. Cable types that will NOT be permitted are listed as follows:
   1. Armored Cable assemblies (AC)
   2. Metal-clad Cable assemblies (MC)
   3. Flat Cable assemblies (FC / FCC)
   4. Integrated Gas Spacer cables assemblies (IGS)
   5. Medium Voltage cable assemblies (MV)
   6. Mineral-Insulated, metal sheathed cable assemblies (MI)
   7. Nonmetallic-Sheathed cable assemblies (NM / NMC / NMS)
   8. Service-Entrance cable assemblies (SE / USE)
   9. Underground Feeder and branch-circuit cable assemblies (UF)
  10. Power and control Tray Cable assemblies (TC)

2.2 CONDUCTOR AND CABLE REQUIREMENTS

A. General Requirements
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide copper conductors.
   3. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.

B. Single Conductor Building Wire
   1. Description: Single conductor insulated wire.
   2. Conductor Stranding:
      b. Size 8 AWG and Larger: Stranded.
   3. Insulation: Type THHN/THWN or THHN/THWN-2.
4. Conductor: Copper.
5. Insulation Voltage Rating: 600 volt.

2.3 CONNECTORS:

A. Description: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.

B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).

C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES:

A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Where conductor size is not indicated, size to comply with NFPA 70 but not less than the minimum size requirements specified below:

1. 20A, 120V circuits less than 75 feet: #12 AWG
2. 20A, 120V circuits longer than 75 feet: Provide #10 AWG

C. In no case shall wiring ampacity exceed the rating of overcurrent device indicated on electrical Panelboard Schedules. Comply with NEC 240.4.

D. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.

E. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

F. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.

G. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect un-spliced wire to numbered terminal strips at each end.

H. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

I. Use splice and tap connectors which are compatible with conductor material.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.
K. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.

L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.

M. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.

N. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.

O. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

P. Thoroughly tape the ends of spare conductors in boxes and cabinets.

Q. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.

R. Parallel conductors shall be cut to the same length.

S. All splices in control panels, terminal junction boxes, low voltage control circuits, MCC buckets, etc., conductors shall be on numbered terminal strips.

T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

U. Provide wire training, lacing, labeling, and terminal blocks as required in all control cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.

3.2 FIELD QUALITY CONTROL:

A. Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The meger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be megered after installation, and prior to termination.

C. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

3.3 COLOR CODING SCHEDULE:

A. Color code secondary service, feeder, and branch circuit conductors as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phase</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208 Volts</td>
<td>Phase</td>
<td>277/480 Volts</td>
</tr>
</tbody>
</table>
B. Conductors shall be solid color for entire length.

C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:

1. Conductors 6 AWG and smaller shall be solid color for the entire length.
2. Conductors 4 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped 3/4 inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

END OF SECTION 26 05 19
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Provide manufacturer's catalog information showing dimensions and materials, for ground rods, connectors and connection materials, and grounding fittings.

C. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.3 QUALITY ASSURANCE:

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS:

A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

B. Conductor Materials: Copper.

2.2 WIRE AND CABLE CONDUCTORS:

A. General: Comply with Division 26 Section on Conductors and Cables. Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors: Conform to the following:
1. Solid Conductors: ASTM B-3
2. Assembly of Stranded Conductors: ASTM B-8
3. Tinned Conductors: ASTM B-33

2.3 MISCELLANEOUS CONDUCTORS:

A. Ground Bus: Bare annealed copper bars of rectangular cross section.
B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.4 CONNECTOR PRODUCTS:

A. General: Listed and labeled as grounding connectors for the materials used.
B. Pressure Connectors: High-conductivity-plated units
C. Bolted Clamps: Heavy-duty units listed for the application. Provide 2-hole compression lugs for all grounding connections when installed on bus bars

2.5 GROUNDING ELECTRODES:

A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
   1. Size: 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATION:

A. Equipment Grounding Conductor Application: Comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
   1. Install separate insulated equipment grounding conductors with circuit conductors for all feeders and branch circuits, in addition to those locations where required by Code:
   2. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.
   3. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing, and surface anti-frost heating cable. Bond this conductor to heater units, piping, and connected equipment and components.

B. All systems shall be grounded in accordance with the NEC.

3.2 INSTALLATION:

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment,
metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

B. Ground Bus: Size, location, and arrangement as indicated in electrical plans. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.

C. Ground Rods: Existing.

D. Metallic Water Service Pipe: Existing

E. UFER Ground: Existing.

F. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

G. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

H. Labeling: Provide a phenolic tag for all grounding electrode conductors as described in section on Electrical Identification.

I. Where grounding conductors, grounding electrode conductors, or bonding conductors are non-exposed, identify each with a 6-inch band of green tape at each end and at 10 foot intervals. When run in conduits, provide color banding on conduit per section on Electrical Identification.

3.3 CONNECTIONS:

A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. 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 assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors. Terminate each conductor on an individual ground lug terminal.

C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

D. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
E.  Moisture Protection:  Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4  FIELD QUALITY CONTROL:

A.  Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling Substantial Completion observations.  Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B.  Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester.  Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

C.  Ground Resistance Test:

1.  Grounding electrode resistance testing shall be accomplished with a clamp-on ground resistance test meter.  Test at all affected points covered under NETA standards. Perform test following final termination of all grounding and bonding connections associated with scope of project.  IEEE Fall of Potential Method may also be used to calculate ground resistance with a direct read meter and two reference probes. At a minimum provide test results at the following locations:
   a.  Service Entrance
   b.  Bond at building steel, UFER ground, and water service
   c.  Telecom ground / bond
   d.  Dry type transformers
   e.  Motor Control Centers (MCC)
   f.  Utilization equipment connection

D.  Correct Deficiencies, Retest and Report:

1.  Correct unsatisfactory conditions and retest to demonstrate compliance; replace conductors, units and rods as required to bring system into compliance.
2.  Prepare a written report and show temperature, humidity and condition of soil at time of tests.  Report shall be certified by testing agency that identifies components checked and describes results.  Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

3.5  CLEANING AND ADJUSTING:

A.  Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.  Where sod has been removed, replace it as soon as possible after backfilling is completed.  Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition.  Include necessary top-soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.  Restore vegetation and disturbed paving to original condition.

END OF SECTION 26 05 26
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:
   A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 SUBMITTALS:
   A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
   B. Shop Drawings: Contractor shall indicate details of fabricated products and materials.
   C. Design Data: Indicate details and engineering analysis for any suspended transformers, cable trays, and trapeze hangers for multiple conduit runs.

PART 2 - PRODUCTS

2.1 COATINGS:
   A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.2 MANUFACTURED SUPPORTING DEVICES:
   A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
   B. Fasteners: Types, materials, and construction features as follows:
      1. Expansion Anchors: Carbon steel wedge or sleeve type.
      2. Toggle Bolts: All steel springhead type.
   C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
   D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
   E. U-Channel Systems: 12-gage steel channels, with 9/16 inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
F. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. One-Hole Conduit Straps: For supporting 1 inch and smaller rigid metal conduit; galvanized steel.
2. Two-Hole Conduit Straps: For supporting 1 inch and larger rigid metal conduit, galvanized steel; 3/4 inch strap width; and 2-1/8 inch between center of screw holes.

2.3 FABRICATED SUPPORTING DEVICES:

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
C. Pipe Sleeves: Provide pipe sleeves of one of either; Steel Pipe (fabricated from Schedule 40 galvanized steel pipe), or metallic conduit (EMT, IMC, or RMC).

2.4 FIRE SEALS:

A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.
B. Flame Spread: 25 or less, ASTM E84
C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
B. Coordinate with the building structural system and with other electrical installation.
C. Junction Box Supports: Comply with the NEC and the following requirement:
   1. Use 1/4 inch all-thread rod from structure to support junction boxes.
D. Raceway Supports: Comply with the NEC and the following requirements:
   1. Conform to manufacturer's recommendations for selection and installation of supports.
   2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
   3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
   4. Use #9 ceiling wire to support individual conduits up to 3/4 inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
5. Support parallel runs of horizontal raceways together on trapeze-type hangers. Use 3/8 inch diameter or larger threaded steel rods for support.

6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. Contractor shall use 1/4 inch-diameter or larger threaded steel for hanger rods with spring steel fasteners. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2 inch or larger conduits provide 3/8 inch minimum threaded steel rods with pipe hangers.

7. Space supports for raceways in accordance with NEC. When (4) or more 2 inch conduits are installed together in a trapeze, supports shall be spaced 5 feet O.C.

8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

9. Threaded rod supports to have bottoms cut off at a maximum length equal to rod diameter below bottom nut.

E. Conductor or Cable Supports: Comply with the NEC and the following requirements:

1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to channel supports anchored to structure (multiple clamps may be secured to a single channel support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.

2. Install simultaneously with installation of conductors.

F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

G. In overhead spaces, support metal boxes directly from the building structure via 1/4 inch minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.

H. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for cable installations as required. Where sleeves through floors are installed, extend above finish floor. For sleeves through fire rated-wall or floor construction, apply UL-listed fire stopping sealant in gaps between sleeves and cables.

I. Conduit Seals: Install seals for conduit penetrations of exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

J. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not
weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

3.2 PERSONNEL PROTECTION:

A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.

B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.

3.3 FIRE STOPPING LOCATIONS:

A. Preparation:

1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.

2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.

B. Installation: Install fire stopping materials in accordance with the manufacturer's instructions.

C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

END OF SECTION 26 05 29
PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.

B. Types of raceways specified in this section include the following:

1. Rigid Metal Conduit (RMC)
2. Liquidtight Flexible Metal Conduit (LFMC)
3. Electrical Metallic Tubing (EMT)

C. The following raceway systems are either specified in other sections or are not anticipated to be provided under this scope of work.

1. High Density Polyethylene (HDPE)
2. Nonmetallic Underground Conduit with Conductors (NUCC)
3. Reinforced Thermosetting Resin Conduit (RTRC)
4. Liquidtight Flexible Nonmetallic Conduit (LFNC)
5. Flexible Metallic Tubing (FMT)
6. Electrical Nonmetallic Tubing (ENT)
7. Rigid Polyvinyl Chloride (PVC)
8. Flexible Metal Conduit (FMC)
9. Intermediate Metallic Conduit (IMC)
10. Auxiliary Gutters / Wireways
11. Surface Raceway
12. Busways and/or Cablebus
13. Cellular Concrete Floor Raceways
14. Underfloor Raceways
15. Cable Trays

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Record Documents: Record actual installed circuiting arrangements and routing for panel feeders and underground circuits.
PART 2 - PRODUCTS

2.1 CONDUIT AND TUBING:

A. General: Aluminum, Brass, and Stainless Steel tubing are not allowed unless specifically noted otherwise and/or for specialty systems such as use in corrosive or special condition environments. Provide galvanizing as indicated below. All fittings shall comply with NEMA FB 1.

B. Rigid Metal Conduit (RMC)

2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.
3. Provide conduit and fittings with external coating of PVC when being installed underground or encased in concrete.

C. Liquid-Tight Flexible Metal Conduit (LFMC)

1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.
2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.

D. Electrical Metallic Tubing (EMT)

1. Conduit: Thinwall steel tubing, unthreaded, with zinc electroplating.
2. Fittings: Steel compression fittings for all applications. Bushings shall be threaded and have nylon insulated throat or nylon bushing.
3. Weatherproof Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for all other connections. Set-screw quick fit type for 2-1/2 inches and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.

2.2 CONDUIT BODIES:

A. General: Types, shapes and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

C. Nonmetallic Conduit: Use nonmetallic conduit bodies.

2.3 CONDUIT SIZES:

A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus parity sized equipment ground.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Provide notification in writing of conditions detrimental to proper completion of
the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions.

3.2 CONDUIT SCHEDULE:

A. General: Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

B. Interior, Damp or Wet Locations: RMC or EMT w/ rain tight fittings.

C. Exposed Interior in utility areas or areas with open ceilings: EMT

D. Exposed Exterior: RMC or Schedule 80 PVC.

E. Connections to Vibrating Equipment: (Such as Transformers and Motors): LFMC, max 6’ length.

F. Raceways in all other areas shall be EMT unless otherwise noted.

G. Rework or extensions of existing conduit shall include the use of similar materials to the existing conduit type unless otherwise noted.

3.3 INSTALLATION OF CONDUITS:

A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:

1. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

2. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

3. Complete installation of electrical raceways before starting installation of conductors within raceways.

4. Provide supports for raceways as specified elsewhere in Division 26.

5. Prevent foreign matter from entering raceways by using temporary closure protection.

6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.

7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.

9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

10. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

11. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.

12. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases provide field bends for parallel raceways.
13. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight.

14. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.

15. Tighten set screws of thread less fittings with suitable tool.

16. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RMC and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2” to 1”. 1-1/4” and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.

17. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

18. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.

19. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded plugs flush with floor.

20. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate ground conductor across flexible connections. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.

21. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.

22. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.

23. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3 piece union or solid coupling.

24. Route conduit through roof openings for piping and ductwork where possible; otherwise, rout through jack with pitch pocket.

25. Conduit stub-ups from below grade or thru the slab shall be PVC coated or PVC taped rigid steel galvanized conduit and shall extend 6 inches above grade.

26. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Engineer.

27. Install an insulated ground conductor in all conduits.

28. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.

29. Use PVC-coated rigid steel or Fiberglass factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length. Use long sweep bends for wiring larger than 350 mcm.

30. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
31. No PVC conduit shall be run exposed or inside stud or masonry walls unless specifically called for on the drawings. Transition from PVC to metal conduit shall be made below grade.

32. Provide separate raceway systems for each of the following:
   a. Lighting
   b. Power Distribution
   c. Temperature Control

B. Install buried electrical line warnings per Division 26 section - “Electrical identification”.

C. Install labeling as required in Division 26 section - “Electrical Identification”.

3.4 ADJUSTING AND CLEANING:

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION 26 05 33
PART 1 - GENERAL

1.1 SUMMARY:
A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:

1. Outlet and device boxes
2. Pull and junction boxes
3. Cabinets
4. Hinged door enclosures

B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

1.2 DEFINITIONS:
A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

1.3 SUBMITTALS:
A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for any control enclosures.

C. Shop Drawings: Provide computer generated drawings of all floor boxes as well as boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated boxes, show accurately scaled views and spatial relationships to adjacent equipment as well as field wiring. Show box types, dimensions, and finishes. Control panels shall include, but not be limited to; lighting and specialized fan.
PART 2 - PRODUCTS

2.1 CABINETS, BOXES, AND FITTINGS, GENERAL:

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.2 MATERIALS AND FINISHES:

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted Interior Finish: Where indicated, white baked enamel. Emergency system cabinets and boxes shall be red.

G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connecters.

2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES:

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

2.4 PULL AND JUNCTION BOXES:

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

2.5 CABINETS:

A. Comply with UL 50, "Electrical Cabinets and Boxes."

B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a
rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.

C. Doors: Double doors for cabinets wider than 24 inches. Telephone cabinets wider than 48 inches may have sliding or removable doors.

D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.6 STEEL ENCLOSURES WITH HINGED DOORS:

A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."

B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.

C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 1 except as indicated. Where door gaskets are required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use appropriate weatherproof raceway entrances.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

C. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

D. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS:

A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.

B. Hinged Door Enclosures Indoor: NEMA type 1 enclosure except as indicated.

C. Hinged Door Enclosures Outdoors: NEMA Type 3R. Install drip hood, factory tailored to individual units.
D. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X nonmetallic enclosure.

E. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:

1. Interior Dry Locations: NEMA Type 1, sheet steel or nonmetallic as permitted by local code.
2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
3. Wet Locations: NEMA Type 4 enclosures.

F. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.3 INSTALLATION OF OUTLET BOXES:

A. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

B. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations
2. Where surface mounted on unfinished walls, columns or pilasters
3. Where exposed to moisture laden atmosphere
4. Where indicated

C. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.

D. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

E. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

F. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

G. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical and/or fire rated walls.

3.4 INSTALLATION OF PULL AND JUNCTION BOXES:

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the allowable limits of the NEC.
B. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

C. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES:

A. Mount with fronts straight and plumb.

B. Install with tops 78 inches above floor.

C. Set cabinets in finished spaces flush with walls.

3.6 GROUNDING:

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.7 CLEANING AND FINISH REPAIR:

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 26 05 34
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Identification labeling for raceways, cables, and conductors
2. Operational instruction signs
3. Warning and caution signs
4. Equipment labels and signs

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

1.3 QUALITY ASSURANCE:

A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS:

A. Identify System Raceways with Painted Couplings & Connectors: Provide painted couplings & connectors for all concealed raceways. Install painted couplings at all conduit connecting couplings including end couplings at stub outs. Apply the following colors:

1. Normal Power: Unpainted
2. Emergency Power: OSHA Orange


1. Label Requirements for Raceways: 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.
2. Label Requirements for Wiring Boxes / Utilization Equipment: See detail on electrical plans for size and text requirements.
   a. 600 Volt and Below Normal: Black Letters on White background indicating source equipment designation, circuit number(s), and voltage.
   b. 600 Volt and Below Emergency: White Letters on Red background
   c. Ground: White or black letters on green background indicating "GROUND" and equipment and designation.

C. Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape, not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at
penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates (Electrical Equipment): Engraving stock melamine plastic laminate, 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved letters on colored face and punched for mechanical fasteners. Apply the following colors:

1. Normal Power: Black letters on White face
2. Emergency Power: Black letters on Red face
3. Ground: White letters on Green face

F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.

H. Adhesive Marking Tape for Device Cover Plates: 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Per Laramie County Community College (LCCC) Construction Quality Standards:
1. All electrical devices shall be labeled including junction boxes above ceilings.
2. Label shall comply with information and requirements as dictated on electrical plan details.

B. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

C. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Conduit Identification: Conduits shall have painted couplings and connectors to identify system cabling contained within. Install labels at 10 foot intervals. Where conduits route above non-accessible ceiling or in floors and walls, labels shall be provided within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned and read the same direction. Where conduits enter or exit a panelboard, pull or junction box, switchboard, or other distribution equipment, conduit labels shall include circuit number in addition to feeder identification and voltage. Use the colors as identified above.

F. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover. Color code shall be same as conduits for pressure sensitive labels. Use self-adhesive marking tape labels at exposed
locations and indelible black marker at concealed boxes. All fire alarm boxes shall have covers painted red. All temperature control boxes shall have covers painted blue.

G. Circuit Identification: Tag or label enclosures and conductors as follows:
   1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
   2. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
   3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
   4. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Every circuit and/or circuit modification shall be uniquely identified to be distinguishable from all other circuits. The identification description shall include an “APPROVED” degree of detail as determined by the State Fire Marshall’s Office. Obtain approval before installing.

H. Apply warning, caution and instruction signs and stencils as follows:
   1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butylate signs with metal backing for outdoor items.
   2. Emergency Operating Signs: Install in Main Electrical Room to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
      a. Provide sign at main service entrance switch, indicating type and location of on-site stand-by generator as required by NEC. Sign shall read “Secondary Source Provided by Engine Generator Located In Room NAME and NUMBER”.

I. Install equipment/system circuit/device identification as follows:
   1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings.

J. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

K. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

L. Tag all grounding electrode conductors, associated bonding conductors, and grounding conductors at their point of attachment to any ground bus and grounding electrode (where possible) with a 2 inch diameter round green phenolic nameplate. Lettering shall be 1/4 inch high with 1/5 inch
between lines centered on the tag stating "DO NOT DISCONNECT," "MAIN GROUND." Nameplate shall attach to conductor with a short length of small chain.

M. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

N. Adhesive Marking Tape for Exposed Cables in Cable Tray: Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.

O. Provide tape labels for identification of individual receptacles including receptacles in furniture systems and light switch wall-plates. Locate tape on front of plate and identify panel/branch circuit serving the receptacle. Provide tape labels for identification of individual switches or thermal overload switches which serve as equipment disconnects. Locate the tape on the front of the cover-plate and identify panel/branch circuit serving the equipment.

END OF SECTION 26 05 53
PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. From electrical source to safety/control equipment
2. From safety/control equipment to motors
3. From motors to secondary controllers (if applicable)
4. To ancillary devices and appurtenances (converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment)
5. To grounding system
6. To master units and/or power distribution units of communications (Div 27) and electronic security systems (Div 28)
7. Other connections as shown within the electrical drawings

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings.

C. Shop Drawings: Provide wiring diagrams where specialized control is details on the plans. Indicate all devices and final enclosure sizes.

D. Coordination Drawings: All mechanical and plumbing equipment shall be coordinated with unit nameplate information per the actual nameplate to be included on the equipment.

E. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.4 DEFINITIONS:

A. Load voltage wiring shall be defined as:
1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to modulate that equipment such as line voltage thermostats, etc., shall be included as control wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall be included as load voltage wiring.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

B. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All motor starters and motor rated switches shall be manufactured by General Electric (GE) Corporation. No equals will be considered.

C. Provide motor controllers that are horsepower rated to suit the motor controlled.

D. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.

E. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

2.2 MATERIALS AND COMPONENTS:

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:
   1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division 26 section on Raceways.

C. Wires, Cables, and Connectors:
   1. General: Provide wires, cables, and connectors complying with Division 26 section on Wires and Cables.
   2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
   3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

2.3 MANUAL MOTOR STARTERS:

A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates.

B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.4 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

B. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.

C. Accessories:

1. Handles shall be lockable in open and closed position without modification.
2. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.5 MOTOR STARTERS:

A. Combination Disconnect Type: Equipment shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Starters shall be complete with properly sized overload protection and pilot light(s). Starters shall be NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Square D Class 8538 or equal.

1. Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
2. Coil Operating Voltage: 120 volts, 60 Hertz
3. Overload Relays: NEMA ICS 2; electronic
4. Overload Element: Select and install overload heater elements in motor controllers provided under this Section to match installed motor characteristics
5. Enclosures: NEMA ICS 6, Type as required to meet conditions of installation.
7. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact
8. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oil tight type
9. Pushbuttons: Unguarded type
10. Indicating Lights: LED type
11. Selector Switches: Rotary type
12. Terminal Blocks: 12-point feed-through type

B. Heater units in all motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.
2.6 AUXILIARY CONTROL DEVICES:
   A. Built in 120 volts control circuit transformer, fused from line side, where service exceeds 120 volts.
   B. Ammeters, Voltmeters, and Frequency Meters: Panel type, 2-1/2 inch minimum size with 90 degree or 120 degree scale and plus or minus 2 percent accuracy. Where indicated. Current Sensors: Rated to suit application.

PART 3 - EXECUTION

3.1 INSPECTION:
   A. Inspect area and conditions under which electrical connections for equipment are to be installed and provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS:
   A. Per Laramie County Community College (LCCC) Construction Quality Standards:
      1. Circuits shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit will not be permitted for this project.
   B. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.
   C. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
   D. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
   E. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.
   F. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
   G. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
   H. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with NEC Appendix I.

J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.

K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.

L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.

M. Provide each motor with a fused disconnect switch for 3 phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged and other equipment for factory installed and field installed motors and controllers.

N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.

O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strips.

P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.

Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

### 3.3 FIELD QUALITY CONTROL:

A. Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

### 3.4 EQUIPMENT CONNECTION SCHEDULES:

A. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Engineer of any discrepancies prior to bidding.
B. Owner Furnished Equipment:
   1. Reconnect existing equipment. Contractor shall field verify requirements prior to bid.

C. For factory pre-wired equipment specified under other Divisions, all wiring within the equipment shall be by the manufacturer. All required field wiring between sections or other field connection details for power and/or control shall be clearly identified on shop drawings for contractor installation. Division 26 drawings show the provided electrical characteristics for equipment.

D. Manufacturer's equipment provided under other divisions which varies from what is shown on Division 26 drawings shall be the responsibility of the Contractor to complete and pay for any costs for those variations.

END OF SECTION 26 05 83
SECTION 26 22 00  
LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY:
A. This section includes general purpose and specialty dry type transformers and voltage regulators with windings rated 600 V or less.

1.2 SUBMITTALS:
A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
B. Product Data: Submit manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, percent taps, polarity, impedance and certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts, % impedance at 75 deg. C, hot-spot and average temperature rise above 40 deg. C ambient temperature, and sound level in decibels.
C. Coordination Drawings: Provide wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring.
D. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.3 QUALITY ASSURANCE:
A. Manufacturers: Firms regularly engaged in manufacture of transformers of types and ratings required for this project, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 TRANSFORMERS, GENERAL:
A. Transformers: Factory assembled and tested air cooled units of types specified, having characteristics and ratings as indicated. Units shall be designed for 60-Hz service.
B. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All dry-type distribution transformers shall be manufactured by General Electric (GE). No equals will be considered.
   2. All 208/120V transformers shall be ‘K Rated’ to a minimum of K13.
C. Cores: Grain oriented, non-aging silicon steel.
D. Coils: Continuous windings without splices except for taps.
E. Internal Coil Connections: Brazed or pressure type.

2.2 GENERAL PURPOSE, DRY-TYPE TRANSFORMERS:
A. Comply with NEMA Standard ST 20 "Dry-Type Transformers for General Applications."
B. Transformers shall have the following features and ratings:

1. Enclosure: Indoor, ventilated. Use the following where specifically shown or appropriate:
   a. Enclosure: Indoor, ventilated, drip proof.

2. Insulation Class: 220 deg. C class

3. Insulation Temperature Rise: 115 deg. C maximum rise above 40 deg. C. for transformers serving general receptacle loads and where specifically shown or otherwise noted.

4. Windings:
   a. 2-winding type, three phase transformers shall use one coil per phase in primary and secondary. Conductors shall be individually insulated, as small in size as possible, and transposed when necessary to minimize eddy current losses. The primary winding shall be of sufficient size to limit temperature rise to its rated value even with circulating 3rd harmonic current.
   b. Provide copper windings.
   c. Windings shall be delta-wye with 30° lagging phase shift to match ANSI standard, unless noted otherwise.

5. Sound Level: Minimum of 3 dB less than NEMA ST 20 standard sound levels for transformer type and size indicated when factory tested in accordance with that standard.

6. Taps: For transformers 3 kVA and larger, full capacity taps in high-voltage winding as follows:
   a. 3 kVA through and including 15 kVA: Two 5 percent taps below rated high voltage.

7. BIL: 10kV for all windings.

8. Secondary Neutral: Twice the ampacity of the secondary phase conductors.

9. Core Flux Density: Maintained below saturation point to prevent core saturation caused by harmonics even with a 10% primary overvoltage.

10. Efficiency: Comply with NEMA standard TP-1 and DOE Energy Efficiency standards.

11. K-Factor: All transformers for LCCC shall be specifically designed to supply 100% of the 60 hertz fundamental rated current and 33% of the fundamental current as third harmonic, 20% of the fundamental current as fifth harmonic, 14% of the fundamental current as seventh harmonic, 11% of the fundamental current as ninth harmonic, and lower proportional percentages of the fundamental current thru the 25th harmonic. The transformers shall be marked with a label stating “Suitable for Non-Sinusoidal Current Load with K factor not to exceed 13 per UL Guide Specifications.

C. Accessories: The following accessory items are required where indicated:

1. Surge Arresters: Low-voltage type, factory-installed and connected to low-voltage terminals; complying with NEMA Standard LA 1.

2. Electrostatic shielding (where indicated): Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection.

3. Fungus Proofing: Permanent fungicidal treatment for coil core.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Arrange equipment to provide adequate spacing for cooling air circulation.

B. Identify transformers in accordance with Division 26 Section on Electrical Identification.
C. Tighten electrical connectors and terminals in accordance with manufacturers published
torque-tightening values. Where manufacturer's torque values are not indicated, use those specified
in UL 486A for copper.

D. Install transformers as indicated, complying with manufacturer's written instructions, applicable
requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized
industry practices to ensure that products fulfill requirements.

E. Install units on vibration mounts; comply with manufacturer's indicated installation method, if any.
Vibration Isolators shall be of the following type if no recommendation is provided:

1. 0.5 kVA through 50 kVA: Double Deflection Neoprene Mounts (DDNM).

3.2 GROUNDING:

A. Ground transformers and tighten connections to comply with tightening torques specified in UL
Standard 486A.

3.3 FIELD QUALITY CONTROL:

A. Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling
Substantial Completion observations. Test results shall be tabulated to show name of tested device,
measured value, expected values, acceptable standard deviation, and test conditions, as well as any
miscellaneous variables that may be applicable to test being performed.

B. Tests shall conform to National Electrical Testing Association (NETA) Standard ATS, "Acceptance
Testing Specifications for Electrical Power Distribution Equipment and Systems," and the following:

1. Test Objectives: To assure transformer installation is operational within industry and
manufacturer's tolerances, is installed in accordance with Contract Documents, and is
suitable for energizing.
2. Procedures: Upon satisfactory completion of tests, attach a label to tested components.
3. Schedule tests and notify Engineer at least one week in advance of schedule and of test
commencement.
4. Reports: Provide a written report of observations and tests. Report defective materials and
workmanship and retest corrected defective items.
5. Submit written test reports to the Engineer.
6. Testing for transformers shall include verification of manual and/or automatic switching,
protection, or control devices, insulation resistance test, taps verification, excitation test, and
audible sound level tests.
7. Provide tap voltage readings and adjust tap connections for appropriate secondary voltage.
Include tap settings and voltage readings in test report.

3.4 ADJUSTING AND CLEANING:

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove
paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish
to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

END OF SECTION 26 22 00
PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.2 DEFINITIONS:

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories. Include information for all overcurrent devices of dedicated feeders to panelboards and motors 1/4 HP or larger, as well as any panelboard main breakers.

1. Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Coordination Drawings: Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.

E. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

F. Record Documents: Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

G. Extra Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.4 QUALITY ASSURANCE:

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 PANELBOARDS, GENERAL REQUIREMENTS:

A. Per Laramie County Community College (LCCC) Construction Quality Standards:

1. All Distribution and Lighting & Appliance (L&A) type panelboards shall be manufactured by General Electric (GE). No equals will be considered.

B. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Overcurrent Protective Devices, with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

C. Enclosures: Flush or surface mounted cabinets as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

D. Front: Hinged trim type, secured to box with 1/4-20-large head slotted captive screws except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified. Provide fronts with hinged trim construction and door with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges on inner door, piano hinge on outer trim door, and door swings as indicated.

E. Directory Frame: Metal, mounted inside each panel door with card and clear plastic cover. Directory shall match panelboard configuration, i.e. top to bottom, left to right. Provide permanent panelboard labels for each circuit number.


G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductor’s bonded to box.

H. Provide lugs for incoming feeders and grounds compatible with bus and feeder material.

I. Provide minimum short circuit current ratings as indicated.

J. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

2.2 LOAD CENTERS:

A. Load Centers are NOT acceptable for use on this project.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS:

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
2.4 IDENTIFICATION:

A. General: Refer to Division 26 Section on electrical identification for labeling materials.

B. UL nameplates shall be provided for all panelboards. Information shall include, but not be limited to, manufacturer, model number, serial number, plant or manufacturing location, ampere rating, voltage rating, wire and phase identification and bus short circuit bracing rating.

C. Provide arc flash warning labels in accordance with NFPA 70.

D. Provide floor markings to clearly indicate required working clearances where indicated or where required by the authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. Mounting: Inside MCC Section.

C. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Every circuit and/or circuit modification shall be uniquely identified to be distinguishable from all other circuits. The identification description shall include an “APPROVED” degree of detail as determined by the State Fire Marshall's Office. Obtain approval before installing.

D. Install filler plates in unused spaces.

3.2 GROUNDING:

A. Connections: Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus indicated.

3.3 CONNECTIONS:

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 LOAD BALANCING:

A. For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 FIELD QUALITY CONTROL:

A. Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
B. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

C. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.

D. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Verify that proper grounding bushings/bonding/ and panel enclosure bonding is complete.
6. Verify isolated neutral bar and neutral connections.

E. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.
3. Test main and sub-feed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

3.6 CLEANING:

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

END OF SECTION 26 24 16
PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes motor-control centers (MCCs) and components for circuits rated 600 V or less.
B. Coordinate controls and other connections with work provided in Division 23 and/or as otherwise indicated.

1.2 SUBMITTALS:

A. See Section 26 05 00 – Common Work Results for submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for each product and component specified.
C. Shop Drawings:
   1. Drawings for each MCC including dimensioned plans and elevations showing equipment and layout respective to mounting space and component lists. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
   2. Schedule of features, characteristics, ratings, and factory settings of individual MCC units.
   3. Wiring Diagrams: Interconnecting wiring diagrams pertinent to the class and type specified for the MCC. Schematic diagram of each type of controller unit indicated. Clearly differentiate between factory and field installed wiring.
D. Field Quality Control Test Reports: Refer to Section 26 05 00 – Common Work Results for additional requirements.
E. Extra Materials:
   1. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type. Include spares for:
      a. Control power fuses
      b. Overloads (heaters)
   2. Spare Indicating Lamps: Furnish 6 of each type and color installed.
F. Operation and Maintenance Data: Include detailed information on system operation, device programming and setup, replacement parts and recommended maintenance procedures and intervals. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.3 QUALITY ASSURANCE:

A. Listing and Labeling: Provide MCCs that are listed and labeled.
   1. The terms "listed" and "labeled": As defined in the National Electrical Code, Article 100.
B. Motor control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4 and NEMA ICS 6.

C. Manufacturers: Firms regularly engaged in manufacture of motor control centers of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

D. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with motor control center installation work similar to that required for project.

E. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for MCCs including clearances between MCCs and adjacent surfaces and items and are based on the types and models indicated. MCCs of other manufacturers having equal performance characteristics and complying with indicated maximum dimensions may be considered. Refer to Product Substitutions requirements.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver in shipping splits of lengths that can be moved past obstructions and through doors to set at locations indicated.

B. Store so condensation, dirt, or construction debris will not accumulate on or in MCCs. Provide temporary heaters as required to prevent condensation.

C. Handle MCCs in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory-installed lifting provisions. Comply with manufacturer's rigging and moving instructions for unloading and transporting them to final locations.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All Campus Distribution Gear shall be manufactured by General Electric (GE). No equals will be considered.

2.2 MOTOR-CONTROL CENTERS:

A. Wiring Classification: Class I, Type B, as defined in NEMA ICS 2.

B. Enclosure: NEMA Type 12, as defined in NEMA 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Except as otherwise indicated. Provide controllers, overcurrent protective devices, control devices, instruments, and any other component mounted on or in the enclosure to match the NEMA type of the enclosure.

C. Compartments: Modular, with individual doors with concealed hinges and quick-captive screw fasteners. For combination starter units provide interlocks so the disconnect means must be in the off position before door can be opened, and so door cannot be closed with the disconnect means in the on position, except by consciously operating a permissive release device.

D. Interchangeability: Construct compartments so it is possible to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing the operation of other units in the control center. Units requiring the same size compartment shall be interchangeable, and
compartments shall be constructed to permit ready rearrangement of units such as replacing 3 single units with a unit requiring 3 spaces without cutting or welding.

E. Wiring Spaces: Provide each vertical section of structure with horizontal and vertical wiring spaces for wiring to each unit compartment in each section. Provide supports to hold wiring rigidly in place.

F. Barriers: Provide barriers between adjacent sections and to isolate the load cable connections from the main buses.

1. Provide rodent barriers to prevent intrusion by pests at the bottom of motor control sections.

G. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in rms symmetrical amperes at the motor-control center location.

H. MCC's shall be designed, constructed, and installed to meet applicable seismic zone requirements.

2.3 BUSES:

A. Bus Material: Provide tin plated hard-drawn copper of 98 percent conductivity.

B. Ampacity Ratings: As indicated for horizontal buses. Provide 300 amp vertical bussing unless noted otherwise. Horizontal and vertical buses shall not be tapered.

C. Neutral Buses: Full size for entire length of bus.

D. Equipment Ground Bus: Non-insulated, horizontal copper bus 2 inches by 1/4 inch minimum.

E. Horizontal Bus Arrangement: Extend main phase, neutral and ground buses with same capacity the entire length of the MCC, with provision for future extension at both ends by means of bolt holes and captive bus splice sections or approved equivalent.

F. Short-Circuit Withstand Rating: Same as or better than short-circuit current rating of section.

G. Bus Supports: Bus supports shall be insulated, high dielectric strength, low power factor, non-hygroscopic, flame retardant, and track resistant material.

H. Provide 2-bolt compression copper lugs for incoming feeders.

2.4 FUNCTIONAL FEATURES:

A. General: Provide a modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in the compartments of the motor-control center as indicated or required. Provide all items listed herein unless otherwise indicated.

B. Provide (FVNR) full-voltage magnetic motor starter with circuit-breaker/fusible disconnect type disconnects and auxiliary control devices unless otherwise indicated. Construct each starter unit with doors, unit support pans, saddles and disconnect operators. Enclose and isolate each unit from adjacent units. Design units so that faults will be contained within compartments. Design plug-in units of same NEMA size and branch feeder units of same trip rating, to be interchangeable with each other. Provide starters with the following ratings, features and accessories:

1. Provide equipment with Short Circuit Current Rating (SCCR).above available fault current.
2. Starters, including contacts and coils, shall be NEMA rated, fully horsepower sized, and rated. IEC sized and rated equipment will not be allowed. Contacts shall open each ungrounded connection to the motor.

3. Equip with ambient temperature compensated, thermal/ magnetic solid state overload protection devices for each motor. Electronic motor overload protection including thermal modeling type thermal protection, Ground fault protection, individual monitoring of motor current in each phase, and a wide FLA adjustment with selectable trip.
   a. Provide trip-free overload relays, set for 115 percent of motor full load amps.
   b. All 3-phase motors 3/4 hp and larger shall be protected against loss of phase and phase reversal wired into the starter or integral to the controller. Differential single phasing protection shall be provided in the overload relay with solid state 3-phase sensing circuit and isolated contacts. If the overload relay does not advance the trip point under phase loss conditions by 25 percent or more, a separate phase protection device shall be factory mounted and wired in the starter enclosure.
   c. Provide Class 10 overload for standard applications and Class 20 for high inertia loads.
   d. Over and Under voltage: The ability for automatic re-start of equipment shall be provided. Settings shall be 110% for overvoltage and 80-95% for under voltage unless stated otherwise on the motor data sheets.
   e. Voltage and current unbalance: Settings shall be 10-15% of FLA for current unbalance alarm with 5-10 second delay and 20-25% of FLA for current unbalance trip with 2-5 second delay unless otherwise stated on the motor data sheets, Phase imbalance shall be adjustable from 2 to 10% with disable setting.


5. Provide maintained contact HAND-OFF-AUTO (H-O-A) selector switches properly arranged and wired for manual speed selection in the HAND position and for remote speed selection in the AUTO position.

   a. Provide line side fuses.

7. Provide pilot lights as follows:
   a. Lights shall be oil resistant type.
   b. Lights shall have a push to test feature.
   c. Running - RED

8. Provide four (4) additional spare sets of auxiliary contacts with each starter, two (2) normally open and two (2) normally closed.

9. Provide control and timing relays, interlocks, pneumatic switches and similar devices as required for coordination with existing Building Management System (BMS).

10. Stop and Lockout Pushbutton Station for equipment connections where not provided in Division 23: Momentary-break pushbutton station with a factory-applied hasp arranged so a padlock can be used to lock the pushbutton in the depressed position with the control circuit open.

C. Overcurrent Protective Devices: Provide types of devices with features, ratings, and circuit assignments indicated, as specified in Division 26 Section on Overcurrent Protective Devices. Individual feeder tap units through 225 ampere rating shall be installed on draw out mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
D. Spare Units: Provide type, sizes, and ratings as indicated, and installed in compartments indicated "spare."

E. Spaces and Blank Units: Compartments shall be fully bussed and equipped with guide rails or equivalent, ready for insertion of draw out units.

F. Provide padlocking provisions on each overcurrent protective device and motor controller lockable in the open or closed position. Provide three (3) sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks, and all accessories necessary.

G. Where reduced voltage starting is required, the starting method shall be solid state electronic starting. Motors shall be constructed accordingly. Other methods of reduced voltage starting shall not be used unless reviewed by the Engineer prior to bid.

2.5 OTHER CIRCUIT CONTROL AND PROTECTIVE DEVICES:

A. General: Factory-installed and -tested devices of types listed below, with indicated ratings, settings, and features.

B. Indicating Lights: For circuit breakers where indicated. Lights shall be oil tight type, push-to-test with lens color as indicated.

C. Control Power: Where electrically operated/ shunt tripped circuit breakers/ or other control power functions are required, provide 120 volt control circuits supplied through secondary disconnect devices from a control power transformer. Include the following features:

1. Control Power Transformers: Dry type. Separate compartments for units larger than 3 KVA and their fuses.
2. Provide two control power transformers in separate compartments with necessary interlocking relays. Connect the primary of each control power transformer at the line side of the associated main circuit breaker. Connect the 120 volt secondary through a relay or relays as a control bus.
4. Provide control power disconnecting means on line side of transformer.
5. Provide control fuse status indication on front and contacts for remote alarm.

D. Control Wiring: Factory installed, complete with bundling, lacing, and protection, and complying with the following:

1. Flexible Conductors: Use for size No. 8 and smaller and for conductors across hinges, and conductors for interconnections between shipping units.
2. Conductors Sizes: In accordance with NEC for the duty required.
3. All control wiring shall be terminated on labeled power type terminal blocks with ring terminals.
4. Limit cable bundles to 12 cables maximum.


1. Description: Coordinate impulse spark over voltage with system circuit voltage, and provide factory mounting and connection.
2.6 IDENTIFICATION PRODUCTS:
   A. Provide identifying devices as specified in Division 26 Section on Electrical Identification.

2.7 FINISHES:
   A. Two coats of baked-on enamel in manufacturer's standard color.

PART 3 - EXECUTION

3.1 INSTALLATION:
   A. General: Install MCCs in accordance with NEMA ICS 2.3 "Instructions for the Handling, Installation, Operation, and Maintenance of MCCs," and with the manufacturer’s written installation instructions.
   B. Anchor each motor-control center assembly to concrete housekeeping pad. Attach by bolting using minimum 3/8 inch bolts.
   C. Limit cable bundles to a maximum of 12 cables per bundle.
   D. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.
   E. Provide two-hole compression connections for all incoming and outgoing phase, neutral, and ground connections.

3.2 IDENTIFICATION:
   A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section on Electrical Identification and as shown on Plan Set Details.

3.3 CONNECTIONS:
   A. Tighten MCC bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer’s installation instructions and torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A.

3.4 GROUNDING:
   A. Provide equipment grounding connections for motor control centers as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.5 FIELD QUALITY CONTROL:
   A. Quality Control Testing Program: Assure MCC installation meets specified requirements, is operational within specified tolerances, and provides appropriate protection for systems and equipment.
      1. Test and inspect MCCs in accordance with manufacturer’s recommendations and these specifications.
      2. Schedule tests and provide notification at least 1 week in advance of test commencement.
4. Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating results, person responsible, and date.

B. Visual and Mechanical Inspection:

1. Inspect MCCs for defects and physical damage, testing laboratory labels, circuit connections, and nameplate compliance with up-to-date system drawings.
2. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check MCC anchorage, external clearances, and alignment and fit of components including internal elements.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection and related work for motor control and protective devices as specified in Division 26 Sections on Overcurrent Protective Devices and Motor Controllers.

C. Electrical Testing:

1. Test insulation resistance of MCC buses; components; and of connecting supply and feeder circuits. For components with solid-state devices or other sensitive components, perform tests in accordance with manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.
2. Make continuity tests of supply, feeder, and control circuits.
3. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformers and control power wiring.
4. Check phasing of supply source to the bus.
5. Test motor-control devices as specified in Division 26 Section on Motor Controllers.
6. Test overcurrent protective devices as specified in Division 26 Section "Overcurrent Protective Devices."
7. Retesting: Correct deficiencies and retest. Verify by the retests that specified requirements are met.

3.6 CLEANING:

A. Inspect interior and exterior of MCCs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7 DEMONSTRATION:

A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate and test MCCs and train Owner's maintenance personnel. Conduct a minimum of 4 hours of training in operation and maintenance as specified under Instructions to Owner Employees in Division 1 Section on Project Closeout. Include training relating to equipment operation and maintenance procedures. Record training on VCR tape and turn training tape over with O&M Manuals.

B. Schedule training with at least seven days' advance notification.
SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles
2. Ground-fault circuit interrupters
3. Switches
4. Wall-plates

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.

C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS:

A. See Section 26 05 00 – Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations. Samples of device plates for color selection and evaluation of technical features shall be submitted with product data.

C. Field Quality Control Test Reports: Refer to Section 26 05 00 – Common Work Results for additional requirements.

D. Operation and Maintenance Data: Include detailed information on system operation, device programming and setup, replacement parts and recommended maintenance procedures and intervals. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.4 COORDINATION:

A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
B. Cord and Plug sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.1 WIRING DEVICES:

A. Color selection shall be verified with Engineer prior to ordering. Devices shall be Ivory.

B. Receptacles:
   1. All devices shall be minimum, specification grade commercial series, listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20 amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug-tail device connections are preferred.

2.2 WIRING DEVICE ACCESSORIES:

A. Verify color and type with Engineer prior to ordering. Device color to match Wiring Device Color identified above.

B. Wall Plates: Provide wall plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the plate, provide grommets in opening to protect cables. Provide plates possessing the following additional construction features:
   1. Material and Finish: 0.04" thick, Nylon, smooth.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All circuits that require GFIC protection shall have the protection integral to the circuit breaker at the Lighting & Appliance Panelboard.
   2. Receptacles with integral GFI protection are NOT acceptable for use on this project.
   3. Circuits shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit will not be permitted for this project.

B. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

C. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

D. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
E. Install wiring devices after wiring work is completed.

F. Install wall plates after painting work is completed.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.

H. Provide GFCI protection as required in NEC 210, including but not limited to: Roof Tops; Outdoors; Indoor Wet locations; Garages; Service Bays; etc.

I. Provide Tamper Resistant (TR) devices for all 120V, 15A and 20A, non-locking receptacles in areas accessible to the general public.

3.2 PROTECTION OF WALLPLATES AND RECEPTACLES:

A. Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING:

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.4 CLEANING:

A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.

3.5 TESTING:

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.

2. Tests for Convenience Receptacles:

   a. Line Voltage: Acceptable range is 114 to 126 V.

   b. Ground Impedance: Values of up to 2 ohms are acceptable.

   c. Polarity: Test for correct neutral conduct to neutral terminal connection.

   d. Using the test plug, verify that the device and its outlet box are securely mounted.

   e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.

   f. SPD receptacle indicating lights for normal indication check.

3. Test Instruments:

   a. Use instruments that comply with UL 1436.
b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Correct Deficiencies and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Prepare a report that identifies enclosure, units, conductors and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 26 27 26
SECTION 26 28 00
ELECTRICAL CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY:
A. This section includes overcurrent protective devices (OCPD's) rated 600 volts and below, as well as switching devices commonly used with them.
B. Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment, such as Panelboards, Switchboards, and Motor Control Centers, are specified in other Division 26 sections.

1.2 DEFINITIONS:
A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 SUBMITTALS:
A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section.
C. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.
D. Extra Materials: Furnish the following for Owner's use in maintenance of project.
   1. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

1.4 QUALITY ASSURANCE:
A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS:

2.1 OVERCURRENT PROTECTIVE DEVICES (OCPDS), GENERAL:
A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.
B. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All Fuses shall be manufactured by Bussman subsidiary of Eaton Corporation. No equals will be considered.
   2. All safety disconnect switches shall be manufactured by General Electric (GE). Owner will also consider product by Cutler-Hammer and/or Square D.

C. Manufacturers: When mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCC's, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

D. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

E. Where OCPD's are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.

F. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.

G. Ground Fault Circuit Interrupters: Where indicated, provide bolt-on panelboard circuit breakers, with integral ground-fault circuit interrupters, UL-rated Class A, Group 1 with interrupt rating adequate for panel. Provide units with solid-state ground-fault sensing and signaling, with 30 mA ground-fault sensitivity trip level. Equip with PUSH-TO-TEST capability. Provide modules which mate and match panelboards in which they are located.

2.2 CARTRIDGE FUSES:

A. General: Comply with NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.

C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.

D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.

A. Comply with UL Standards for Safety Class R Fuses. UL 198E
   1. Class RK5 Fuses: Duel Element, Time Delay, Type FRS

2.3 FUSIBLE SWITCHES:

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Provide rejection type fuse clips.

G. Mounting: Suitable for mounting in MCC.

H. Contacts shall be NEMA rated 75 degrees C.

I. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

J. Provide fast acting, auxiliary contacts for disconnects supplied from variable frequency drives that will trigger freewheel stop on the drive before the main three-phase contacts open.

2.4 MOLDED-CASE CIRCUIT BREAKERS:

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Provide bolt-in type, except breakers 225-ampere frame size and larger which may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.

F. Enclosure for Switchboard, Motor Control Center, or Panelboard Mounting: Suitable for mounting in equipment indicated.

PART 3 - EXECUTION:

3.1 INSTALLATION:

A. Per Laramie County Community College (LCCC) Construction Quality Standards:
   1. All circuits that require AFC protection shall have the protection integral to the circuit breaker at the Lighting & Appliance Panelboard.
   2. Receptacles with integral AFC protection are NOT acceptable for use on this project.
   3. All Fuses shall be manufactured by Bussman subsidiary of Eaton Corporation. No equals will be considered.
B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD’s in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.

C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.

D. All fuses for new disconnect switches or MCC’s feeding motors or motor starters shall be provided with Class H or K fuses.

E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.

F. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Fire detection and alarm circuits
   2. Video surveillance system circuits

3.2 IDENTIFICATION:

A. Identify components in accordance with Division 26 Section on electrical identification.

B. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.

   1. Description included on electrical panel schedules are for design purposes only. Description printed on final panel schedules must have a sufficient degree of detail that allows each circuit to be distinguished from all others, as approved by the Authority Having Jurisdiction.

3.3 CONTROL WIRING INSTALLATION:

A. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

B. Install wiring between OCPDs and control/indication devices.

3.4 CONNECTIONS:

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values. Where manufacturer’s torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING:

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.
3.6 **FIELD QUALITY CONTROL:**

A. Provide all test results to Engineer in Substantial Completion Submittals prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.

B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

C. Make adjustments for final settings of adjustable-trip devices.

D. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt-trip devices.

E. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.

F. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

3.7 **CLEANING:**

A. Upon completion of installation, inspect OCPD’s. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

**END OF SECTION 26 28 00**
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