

**ADDENDUM NO. #5
CITY OF TRUTH OR CONSEQUENCES
MAIN STREET DISTRICT (MSD)
WATER SYSTEM IMPROVEMENTS**

March 17, 2022

TO: All Holders of Contract Documents For:

**FOR: CITY OF TRUTH OR CONSEQUENCES MAIN STREET DISTRICT (MSD) WATER
SYSTEM IMPROVEMENTS**

FROM: Wilson & Company Inc.

The following Addendum #5 shall be incorporated into the Contract Documents for the above referenced project.

ADDENDUM NUMBER FIVE (5):

Updated State wage rates will be sent out in the next addendum

1. The Bid Date has been extended from 03/24/2022 at 2:00 PM to **03/31/2022 at 2:00 PM**. Bids will still be collected at City of Truth or Consequences Finance Department located at 505 Sims Street, Truth or Consequences, NM, until March 31, 2022, at 2:00 pm MST local time. At 2:30 pm MST, March 31, 2022, the Bids received will be moved to the Commission Chambers at 405 W 3rd Street, Truth or Consequences, NM and will be publicly opened and read.
2. Bid Form for Construction Contract (C-410) updated, Line item 52 "Dewatering of Trench and Bore Pits, CIP" Included. It was inadvertently left out on the Addendum #3 corrections.
3. Technical Specification 26 2419 "Motor Control Center "included. It was inadvertently left out of the specifications.

ALL OTHER PROVISIONS OF THE CONTRACT DOCUMENTS SHALL REMAIN UNCHANGED. THIS ADDENDUM IS HEREBY MADE A PART OF THE CONTRACT DOCUMENTS TO THE SAME EXTENT AS THOSE PROVISIONS CONTAINED IN THE ORIGINAL DOCUMENTS AND ALL ITEMIZED LISTINGS THEREOF.

Each bidder shall acknowledge receipt of the Addendum No. FIVE (5) on the Bid Form in the space provided.



Mark A. Nasi P.E. # 13076
Wilson & Company

DATE: 03/17/2022



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BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

- 1.01 This Bid is submitted to: **City of Truth or Consequences, 505 Sims St. Truth or Consequences, NM 87901**
- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

- 2.01 The following documents are submitted with and made a condition of this Bid:
 - A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;
 - E. Contractor's license number as evidence of Bidder's State Contractor's License or a covenant by Bidder to obtain said license within the time for acceptance of Bids;
 - F. Required Bidder Qualification Statement with supporting data;
 - G. If Bid amount exceeds \$10,000 signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in the Supplementary Conditions of the Construction Contract (EJCDC C-800);
 - H. If Bid amount exceeds \$25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AS-1048);
 - I. If Bid amount exceeds \$100,000, signed RD Instruction 1940-Q Exhibit A-1, Certification for Contracts, Grants, and Loans.;
 - J. [List other documents and edit above as pertinent].

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

- 3.01 *Unit Price Bids*
 - A. Bidder will perform the following Work at the indicated unit prices:

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Amount
ALLOWANCES AND MISCELLANEOUS					
1	Mobilization & Demobilization	LS	1		
2	SWPPP Preparation	LS	1		
3	SWPPP Implementation and inspection	LS	1		
3	NPDES Compliance	LS	1		
4	Construction Sign	LS	1		
5	Construction Survey to include staking, layout and identifying project boundaries.	LS	1		
6	Traffic Control	LS	1		
7	Utility Relocation	ALLW	1	\$50,000	\$50,000
8	Material Testing Allowance	ALLW	1	\$56,488	\$56,488
9	Subsurface Utility Locating/Pot Holing	ALLW	1	\$50,000	\$50,000
10	SCADA Allowance	ALLW	1	\$150,000	\$150,000
COOK ST. TREATMENT FACILITY CONSTRUCTION ITEMS					
11	Site Grading/Excavation	CY	1,000		
12	Engineered Fill/Subgrade Prep for Tank Foundation, Including Compaction and Testing	CY	630		
13	6-Inch Gravel Pad, Including Subgrade Prep, Installed	SY	821		
14	Furnish and Install 0.300 Million Gallon Welded Steel Tank, AWWA D100-11,CIP	LS	1		
15	Tank Foundation, Installed	LS	1		
16	Furnish and Install Cathodic Protection for Tank, Complete in Place	LS	1		
17	Furnish and Install 18-Inch DIP, Including Trenching and Compacted Backfill, per APWA Standard Spec. 801, Complete in Place	LF	350		
18	Finish and install Val-Matic Check valve, CIP	EA	2		
19	Furnish and install ARV W/ Furnish and appurtenances, CIP	EA	2		
20	Furnish and Install 10" E+H Magmeter, Promag W400, 5W4C2F, DN30 12 9'X5' in precast concrete vault with bypass, and new chlorine injection port. CIP	LS	1		
21	Furnish and install 300 HP Booster Pump and Motor W/ VFD @ Cook Street Booster Station	EA	2		
22	Ductile Iron MJ fittings, class 250,18" Waterlines incl. Joining Material	LB	5,835		
23	Furnish and Install 10-Inch Cast Iron Gate Valve (MJ)	EA	2		
24	Furnish and Install 12-Inch Cast Iron Gate Valve (MJ)	EA	2		
25	Connect to Existing 18-Inch Waterline, Complete in Place	EA	2		
26	Furnish and install new gas- chlorination disinfection system, including fiberglass shed,CIP.	EA	1		

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Amount
27	Generator, 1MW, 480/277V, 3 Phase, 4W, Diesel Unit and Generator Pad, including subgrade prep reinforcement, Installed	LS	1		
28	Chlorination Building Foundation Pad, including subgrade prep reinforcement, Installed	LS	1		
29	Furnish and Install 18-Inch DI Mechanically Restrained Joint Assembly, per APWA Standard Spec. 801, Complete in Place	EA	40		
30	12" E+H Magmeter, Promag W400, 5W4C3H, DN30 12, 7'X7' in precast concrete vault with bypass.CIP	EA	1		
IMPROVEMENTS TO DISTRIBUTION SYSTEM					
31	6-inch FPVC C-900, DR 18 PVC Pipe: Horizontal Directional Drill	LF	38		
32	8-inch FPVC C-900, DR 18 PVC Pipe: Horizontal Directional Drill	LF	1126		
33	12-inch FPVC C-900, DR 18 PVC Pipe: Horizontal Directional Drill	LF	315		
35	8" Waterline C-900 DR-18 PVC Pipe Installed	LF	2,142		
36	12" Waterline C-900 DR-18 PVC Pipe Installed	LF	5,241		
36.A	6-inch FPVC C-900, DR 18 PVC Pipe: Pipe Bursting Method	LF	935		
37	8-inch FPVC C-900, DR 18 PVC Pipe: Pipe Bursting Method	LF	1084		
38	12-inch FPVC C-900, DR 18 PVC Pipe: Pipe Bursting Method	LF	177		
39	6" PVC pipe restrained coupling installed Series #3800S	EA	6		
40	8" PVC pipe restrained coupling installed Series #3808S	EA	7		
41	12" PVC pipe restrained coupling installed Series #3812S	EA	1		
42	6" Gate Valves w/ Valve Can, CIP	EA	23		
43	8" Gate Valves w/ Valve Can, CIP	EA	41		
44	12" Gate Valves w/ Valve Can, CIP	EA	36		
45	4 1/2'-Depth Fire Hydrant w/ piping valves, and connection	EA	1		
46	3 1/2'-Depth Fire Hydrant w/ piping valves, and connection	EA	11		
47	Pressurized waterline connections, CIP	EA	9		
48	Ductile Iron MJ Fittings, All Sizes, Class 25, CIP	LB	15,255		
49	Joint Restraints 4"-8", CIP	EA	181		
50	Joint Restraints 10"-12", CIP	EA	314		
51	Water Meter Box Remove & Replace,incl connectors & smart valve, compl.	EA	119		
52	Dewatering of Trench and Bore Pits, CIP	lf	3,000		
53	Temporary water services	LF	3,500		

EJCDC® C-410, Bid Form for Construction Contract.

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Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Amount
54	Temporary Service connection	EA	32		
ROADWAY					
55	Asphalt Roadway, Remove, Dispose and Replace with SP III, 3" Thick for Residential Streets, include Subgrade Prep, CIP	SY	382		
56	Asphalt Roadway, Remove, Dispose and Replace with SP III, 6" Thick for NMDOT ROW, include Subgrade Prep, CIP	SY	7,129		
57	Excavate and Dispose of Unsuitable Material, CIP	CY	11,398		
58	Import of select material	CY	11,398		
59	Geogrid Base Roadway Reinforcement	SY	7,510		
60	Remove and replace Curb and Gutter, CIP	LF	580		
61	Remove and replace Sidewalk, CIP	SY	339		
ELECTRICAL / CONTROLS					
62	Well 1 Demolition and Installation, CIP	LS	1		
63	Well 2 Demolition and Installation, CIP	LS	1		
64	Well 6 Demolition and Installation, CIP	LS	1		
65	Well 7 Demolition and Installation, CIP	LS	1		
66	Well 8 Demolition and Installation, CIP	LS	1		
67	Morgan St. Demolition and Installation, CIP	LS	1		
68	Cemetery St. Demolition and Installation, CIP	LS	1		
69	Cook St. Demolition and Installation, CIP	LS	1		
70	Cook St. 3 Phase, 480 V, Diesel Generator	EA	1		
MECHANICAL					
71	Cook St. Demolition, Plumbing, HVAC and Installation, CIP	LS	1		
CONSTRUCTION SUBTOTAL				\$	-
NMGRT (8.5%)				\$	-
TOTAL ESTIMATED PROJECT COSTS				\$	-

B. Bidder acknowledges that:

1. each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and
2. estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents.

3.02 *Total Bid Price (Lump Sum and Unit Prices)*

Total Bid Price (Total of all Lump Sum and Unit Price Bids)	\$
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ARTICLE 4—BASIS OF BID—COST-PLUS FEE “DELETED”

ARTICLE 5—PRICE-PLUS-TIME BID “DELETED”

ARTICLE 6—TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 **“Deleted”**

6.03 **“Deleted”**

6.04 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7—BIDDER’S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

7.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

7.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

8.01 *Bidder’s Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.

2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work, including all American Iron and Steel requirements.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

8.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
 - d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Address for giving notices:

Bidder's Contact:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address: _____

Bidder's Contractor License No.: (if applicable) _____

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

26 2923 Variable Frequency Motor Controller

1.2 SUMMARY

- A. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:

1. Automatic power transfer.
2. Feeder-tap units.
3. Measurement and control.
4. Auxiliary devices.
5. Panelboards.
6. Transformers.
7. SPD
8. Motor Starters/VFD/soft starts/disconnects (fused or non-fused)

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCC: Motor-control center.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor-circuit protector.
- E. OCPD: Overcurrent protective device.
- F. PID: Control action; proportional plus integral plus derivative.
- G. PT: Potential transformer.
- H. SPD: Surge protective device.
- I. SCR: Silicon-controlled rectifier.

- J. VFC: Variable-frequency controller.
- K. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.
- B. Shop Drawings: For each MCC, manufacturer's custom and production drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
 - f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
 - g. Specified optional features and accessories.
 - h. Motor starters, variable frequency drives, panels, transformers, metering, disconnect switches (fused and non-fused), SPD and soft starts.
 - i. Horizontal and vertical buss (non-insulation and insulated) rating and configuration.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
 - 3. Nameplate legends.
 - 4. Vertical and horizontal bus capacities.
 - 5. Features, characteristics, ratings, and factory settings of each installed unit.

1.5 INFORMATIONAL SUBMITTALS

- A. Standard Drawings: For each MCC, as defined in UL 845.
- B. Production Drawings: For each MCC, as defined in UL 845.

- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around MCCs where pipe and ducts are prohibited. Show MCC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For testing agency.
- E. Seismic Qualification Data: Certificates, for MCCs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Product Certificates: For each MCC.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Load-Current and Overload Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- J. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
- K. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
 - 3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 4. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 5. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
 - 6. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

7. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Power Fuses: Equal to 20 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 20 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: six of each type and color installed.
 4. Auxiliary Contacts: Furnish four spare(s) for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.
- D. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.
- B. Handle MCCs according to the following:
 1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
 2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
- C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; install temporary electric heating, with at least 250 W per vertical section.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCC and all devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton
- B. Square D
- C. General Electric

2.2 SYSTEM DESCRIPTION

- A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.
- B. Ambient Environment Ratings:
 - 1. Ambient Temperature Rating: Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C), with an average value not exceeding 95 deg F (35 deg C) over a 24-hour period.
 - 2. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
 - 3. Humidity Rating: Less than 95 percent (noncondensing).
 - 4. Altitude Rating: Not exceeding 6600 feet (2000 m), or 3300 feet (1000 m) if MCC includes solid-state devices.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: MCCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 - 2. Component Importance Factor: **[1.5]** **[1.0]**.
 - 3. Component Amplification Factor: 2.5.
 - 4. Component Response Modification Factor: 6.0.

B. Capacities and Characteristics:

1. MCC Enclosure and Assembly:
 - a. Nominal System Voltage: **277/480-V ac.**
 - b. Service Equipment Rated: [**Yes.**
 - c. Enclosure: NEMA 250, Type 3R.
2. Integrated Short-Circuit Rating for MCC:
 - a. Fully rated; 65 kA.
3. Integrated Short-Circuit Rating for Each Unit:
 - a. Fully rated; 65 kA.
4. Wiring Class: Class II Type B.
5. Bus:
 - a. Horizontal Bus: 65 kA.
 - b. Neutral Bus: 150 percent.
6. Main Disconnect Device:
 - a. Main Disconnect: Manually operated, electrically tripped.
 - b. SPD: UL 1449, Type 1.
7. Automatic Power Transfer: Electrically operated MCCBs, three pole.
8. Magnetic Controllers:
 - a. Tag Number: as referenced in drawings.
 - 1) Classification by Starting Method: FVNR,FVR.
 - 2) Controller Size: complying with NEMA ICS 2.
9. Reduced-Voltage Solid-State Controllers:
 - a. Tag Number: as referenced in drawings.
 - 1) Starting Configuration: FVNR/FVR
 - 2) Starting Mode: HOA
 - 3) Stopping Mode: HOA
 - 4) Controller Size: complying with NEMA ICS 2.
 - 5) Bypass Contactor: Comply with NEMA ICS 2.
 - 6) Acceleration Control: PWM.
 - 7) Overload Relays: Solid state
 - 8) Isolated Overload Alarm Contact: 2-NC 2-NO.
 - 9) Optional Features: Auxiliary Contacts 2-NC, 2-NO.

10. VFCs:
 - a. Tag Number: .
 - 1) Bypass Mode: Field selectable, manual or automatic
 - 2) Bypass Style: Three contactor style.
 - 3) Bypass Contactor Classification: Full-voltage (across-the-line).
 - 4) Overload Relays: Solid state
 - 5) Isolated Overload Alarm Contact: 2-NC, 2-NO.
 - 6) Optional Features: . Auxiliary Contacts 2-NC, 2-NO; Bypass Auxiliary Contacts 2-NC, 2-NO. Ethernet Connection (MODBUS TCP/IP)
11. Controller-Mounted Auxiliary Devices:
 - a. Push Buttons and Selector Switches: Heavy-duty, oiltight type.
 - b. Feeder Tap Units: Main Disconnect: Manually operated, electrically tripped.
12. Panelboards: Tag Number as shown on drawings.
 - a. Mains As shown on drawings.
 - b. Bolt-on circuit breakers.
13. Transformer(s): Tag Number as shown on drawings.
 - a. Primary Circuit Breaker: as shown on drawings.
14. Transfer Switch: Tag Number as shown on drawings.

2.4 MOTOR CONTROL CENTER ENCLOSURES

- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 12 unless otherwise indicated to comply with environmental conditions at installed location.
- B. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point 120-V external branch circuit.
- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Outdoor Enclosures: Type 3R, non-walk-in aisle.
 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 2. Enclosure: Downward, rearward sloping roof; rear hinged doors for each section, with provisions for padlocking.
 3. Doors: Personnel door at each end of aisle, minimum width of 30 inches (762 mm); opening outwards; with panic hardware and provisions for padlocking.

4. Accessories: Fluorescent luminaires, ceiling mounted; wired to a three-way light switch at each end of aisle; GFCI duplex receptacle; emergency battery pack luminaire installed on wall of aisle midway between personnel doors.
5. Walk-in Aisle Heating and Ventilating:
 - a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F (5 deg C) with outside design temperature of plus 23 deg F (minus 5 deg C).
 - b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F (38 deg C) with outside design temperature of 104 deg F (40 deg C).
 - c. Ventilating openings complete with replaceable fiberglass air filters.
 - d. Thermostat: Single stage; wired to control heat and exhaust fan.
6. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a CPT within the switchboard. Supply voltage shall be 120-V ac.
7. Power for space heaters, ventilation, lighting, and receptacle supplied from a remote source.

2.5 ASSEMBLY

A. Structure:

1. Comply with UL requirements for service entrance equipment.
2. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
3. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.
4. Pull Boxes:
 - a. Include provisions for ventilation to maintain temperature in pull box within same limits as the MCC.
 - b. Set the box back from front to clear circuit-breaker removal mechanism.
 - c. Covers: Removable covers forming top, front, and sides.
 - d. Insulated bottom of fire-resistive material with separate holes for cable drops into MCC.
 - e. Cable Supports: Arranged to facilitate cabling and adequate to support cables, including supports for future cables.
 - f. When equipped with barriers, supply with access to check bus bolt tightness.

B. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners.

1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.

2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
 3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- C. Bus Transition and Incoming Pull Sections: Included and aligned with the structure of the MCC.
- D. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and PTs or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic MCC. Install service entrance label and applicable service entrance features. Comply with requirements in Section 262713 "Electricity Metering."
- E. Owner's Metering Compartment: A separate customer metering compartment and section with front hinged door, metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include PTs having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
- F. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same-size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- G. Wiring Spaces:
1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
 2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.
- H. Provisions for Future:
1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.
 2. Compartments marked "spare" shall include provisions for connection to the vertical bus.
- I. Integrated Short-Circuit Rating:
1. Short-Circuit Current Rating for Each Unit: Fully rated; 65 kA.
 2. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 65 kA.

J. Control Power:

1. 120-V ac, supplied centrally from a CPT.
2. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 200 VA.
3. Control Circuits: 24-V dc, supplied centrally from two redundant, automatically switched power supplies.
4. CPT Spare Capacity: 200 VA.

K. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

1. Wiring Class: NEMA ICS 18, Class II Type B, for all starters.
2. Wiring Class: NEMA ICS 18, Class II Type B, for all starters.
3. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

L. Bus:

1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions from both ends.
2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity or silver-plated alloy, with compression connectors for outgoing conductors.
4. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches (6 by 50 mm). Equip with compression connectors for outgoing conductors.
5. Neutral Disconnect Link: Bolted, uninsulated, 1/4-by-2-inch (6-by-50-mm) copper bus, arranged to connect neutral bus to ground bus.
6. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Insulation temperature rating shall not be less than 105 deg C.

2.6 MAIN DISCONNECT AND OVERCURRENT PROTECTIVE DEVICE(S)

- A. MCCB (to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.
1. MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be shown by the position of the handle, and manual push-to-trip push button.

2. Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.
 - a. Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
 - b. Trip-setting dials or interchangeable plugs to establish the continuous trip of the circuit breaker. Plugs shall not be interchangeable between frames, and the breaker may not be closed without the plug. With neutral ground-fault sensor.
 - c. Time-current adjustments to achieve protective-device coordination as follows:
 - 1) Adjustable long-time delay.
 - 2) Adjustable short-time setting and delay to shape the time-current curve.
 - 3) Adjustable instantaneous setting.
 - 4) Individually adjustable ground-fault setting and time delay.
 - d. Built-in connector to test the long-time delay, instantaneous, and ground-fault functions of the breaker. Provide one test set for testing the installed circuit breakers 225-A frame and higher.
 - e. Built-in digital ammeter display, showing load current and tripping cause.
 3. Switch operator power shall be from control power specified in "Assembly" Article.
- B. MCCB (1600 to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.
1. MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be indicated by the position of the handle, and manual push-to-trip push button.
 2. Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.
 - a. Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
 - b. LED indicators or display, with manual reset, to show reasons of automatic trip.
 - c. Display panel to indicate the status of the system circuitry, or give fault location based on automatic diagnosis.
 - d. Trip the circuit breaker when closing on a fault.
 - e. Time-current adjustments to achieve protective-device coordination as follows:
 - 1) Adjustable long-delay pickup and time.
 - 2) Individual adjustments for short-delay pickup, time, and I-squared-t setting.
 - 3) Adjustable instantaneous pickup.
 - 4) Individually adjustable ground-fault pickup and time, with I-squared-t setting.
 - f. One test kit to test each trip function.
 - g. Battery backup for informational displays after automatic trip, with battery status indicator.

3. Switch operator power shall be from control power specified in "Assembly" Article.
- C. MCC Main Disconnect Device: Fusible switch; fixed-mounted, manually operated, electrically tripped, quick-make, quick-break switch. Comply with UL 98.
1. Indication whether the switch is open or closed, and provisions for padlocking the operating handle.
 2. Fuse clips and fuses.
 3. Electrically tripped switches shall include the following:
 - a. Shunt trip.
 - b. Ground-fault protection, with adjustable time delay and test panel.
 - c. Single-phase protection, tripping the switch on loss of a source phase.
 - d. Blown fuse protection, tripping the switch on a blown fuse, with blown fuse indication.
 - e. Switch operator power shall be from control power specified in "Assembly" Article.
- D. Surge Suppression: Factory installed as an integral part of the incoming feeder, complying with UL 1449, SPD **Type 1**.

2.7 MAGNETIC CONTROLLERS

- A. Controller Units: Combination controllers.
- B. Disconnects:
1. Fusible Switch:
 - a. UL 98 and NEMA KS 1, heavy-duty, horsepower-rated fusible switch, with clips or bolt pads to accommodate UL 248-10 Class L fuses.
 - b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: 2-NC and 2-NO, arranged to activate before switch blades open.
 2. MCP:
 - a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. 2-NC and 2-NO] alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

3. MCCB:
 - a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: For three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
 - e. [NC] [NO] alarm contact that operates only when MCCB has tripped.

4. Molded-Case Switch:
 - a. UL 489, with in-line fuse block for UL 248-10 Class L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
 - b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
 - d. 2-NC and 2-NO alarm contact that operates only when molded-case switch has tripped.

C. Controllers: Comply with UL 508.

1. Full-Voltage Magnetic Controllers: Electrically held, full voltage, NEMA ICS 2, general purpose, Class A.
 - a. Classification: Nonreversing and reversing.

2. Reduced-Voltage Magnetic Controllers: Electrically held, NEMA ICS 2, general purpose, Class A; closed transition; adjustable time delay on transition. Electrically held.
 - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 - b. Part-Winding Controller: Separate START and RUN contactors, with separate overload relays for starting and running sequences.
 - c. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; one RUN and two START contactors.

3. Multispeed Magnetic Controllers: Electrically held, full voltage, NEMA ICS 2, general purpose, Class A.
 - a. Classification: Nonreversing; two winding.
 - 1) Two speed, with compelling relays to ensure that motor will start only at low speed.
 - 2) Timer Relays: Accelerating, for properly timed acceleration through speeds lower than that selected.

- 3) Timer Relays: Decelerating, for automatically timed deceleration through each speed.
 - b. Classification: Reversing; two winding.
 - 1) Two speed, with compelling relay to ensure that motor will start only at low speed.
 - c. Timer Relays: Accelerating, for properly timed acceleration through speeds lower than that selected.
 - d. Timer Relays: Decelerating, for automatically timed deceleration through each speed.
 - e. Antiplugging Relays: Time delay when transferring from FORWARD to REVERSE and back.
- D. Overload Relays:
- 1. Solid-State Overload Relays:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. UL 1053 Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 - 2. 2-NC and NO isolated overload alarm contact.
 - 3. External overload reset push button.

2.8 VFC

- A. Controller Units: Combination controllers, consisting of variable-frequency power converter that is factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged for self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency. Comply with NEMA ICS 7, NEMA ICS 61800-2, UL 508C, and UL 508E.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
 - 4. Listed and labeled for single-phase use by an NRTL acceptable to authorities having jurisdiction.

B. Disconnects:

1. Fusible Switch:

- a. UL 98 and NEMA KS 1, heavy-duty, horsepower-rated fusible switch, with clips or bolt pads to accommodate UL 248-10 Class L fuses.
- b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
- c. Auxiliary Contacts: 2-NC and 2-NO, arranged to activate before switch blades open.

2. MCP:

- a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
- c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
- d. 2-NC and 2-NO alarm contact that operates only when MCP has tripped.
- e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

3. MCCB:

- a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- c. Lockable Handle: For three padlocks and interlocks with cover in closed position.
- d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
- e. 2-NC and 2-NO alarm contact that operates only when MCCB has tripped.

4. Molded-Case Switch:

- a. UL 489, with in-line fuse block for UL 248-10 Class L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
- b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
- c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
- d. 2-NC and 2-NO alarm contact that operates only when molded-case switch has tripped.

5. Disconnect Rating: Not less than 115 percent of VFC input current rating.

6. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

7. Auxiliary Contacts: 2-NC and 2-NO, arranged to activate before switch blades open.

8. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

9. 2-NC and 2-NO alarm contact that operates only when circuit breaker has tripped.

C. Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Overload Capability:
 - a. For variable-torque controllers, 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - b. For constant-torque controllers, 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
7. Starting Torque: Minimum of 100 percent of rated torque from 3 to 60 Hz.
8. Speed Regulation: Plus or minus **5** percent.
9. Output Carrier Frequency: Field selectable.
10. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
11. Internal Adjustability Capabilities:
 - a. Minimum Speed: 5 to 25 percent of maximum rpm.
 - b. Maximum Speed: 80 to 100 percent of maximum rpm.
 - c. Acceleration: 0.1 to 999.9 seconds.
 - d. Deceleration: 0.1 to 999.9 seconds.
 - e. Current Limit: 30 to a minimum of 150 percent of maximum rating.
12. Self-Protection and Reliability Features:
 - a. Input transient protection by means of SPDs for three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - b. Loss of Input Signal Protection: Selectable response strategy including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - c. Under- and overvoltage trips.
 - d. Inverter overcurrent trips.
 - e. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved and listed and labeled by an NRTL.
 - f. Critical frequency rejection, with **three** selectable, adjustable deadbands.
 - g. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - h. Loss-of-phase protection.
 - i. Reverse-phase protection.
 - j. Short-circuit protection.
 - k. Motor overtemperature fault.

13. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
14. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

D. Operator Station:

1. Inverter Logic: Microprocessor based, **32** bit, isolated from all power circuits.
2. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
3. Panel-mounted, manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - a. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - b. Security Access: Electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

E. Displays:

1. Historical Logging Information and Displays:
 - a. Real-time clock with current time and date.
 - b. Running log of total power versus time.
 - c. Total run time.
 - d. Fault log, maintaining last four faults with time and date stamp for each.
2. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including the following:
 - a. Output frequency (Hz).
 - b. Motor speed (rpm).
 - c. Motor status (running, stop, fault).
 - d. Motor current (amperes).
 - e. Motor torque (percentage).
 - f. Fault or alarming status (code).
 - g. PID feedback signal (percentage).
 - h. DC-link voltage (V dc).
 - i. Set-point frequency (Hz).
 - j. Motor output voltage (V ac).

F. Bypass Systems:

1. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes, and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

2. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.
3. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.
4. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
 - a. Bypass Contactor: Load-break, NEMA-rated contactor.
 - b. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
 - c. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
5. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - a. Bypass Contactor: Load-break, NEMA-rated contactor.
 - b. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
 - c. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
6. Bypass Contactor Classification: Full-voltage (across-the-line) type.
7. NORMAL/BYPASS selector switch.
 - a. HAND/OFF/AUTO selector switch.
 - b. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
 - c. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - 1) Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 2) Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
8. Overload Relays: NEMA ICS 2.
 - a. Solid-State Overload Relays:
 - 1) Switch or dial selectable for motor-running overload protection.

- 2) Sensors in each phase.
 - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - 5) Analog communication module.
- b. 2-NC and 2-NO isolated overload alarm contact.
 - c. External overload reset push button.
- G. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- I. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- J. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, the following password-protected input:
- 1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
 - 2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
 - 3. Forces VFC to transfer to bypass mode and operate motor at full speed.
 - 4. Causes display of override mode on the VFC display.
 - 5. Reset VFC to normal operation on removal of override signal manually.
- K. Communication Port: Ethernet or equivalent connection Capable of connecting a printer and a notebook computer.

2.9 CONTROLLER-MOUNTED AUXILIARY DEVICES

- A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.
- 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Lockable types; maintained contact unless otherwise indicated.
 - b. Pilot Lights: LED types; push to test.
 - c. Selector Switches: Rotary type.

- B. Elapsed-Time Meters: Heavy duty with digital readout in hours resettable.
- C. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy, with selector switches having an off position.
- D. Auxiliary Dry Contacts: 2-NC and 2-NO.
- E. Control Relays:
 - 1. Time Delay: Auxiliary and adjustable solid-state time-delay relays.
 - 2. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections and adjustable undervoltage, overvoltage, and time-delay settings.

2.10 MEASUREMENT AND CONTROL DEVICES

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 - 1. PTs: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; double secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, for selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker and ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Listed or recognized by a nationally recognized testing laboratory.
 - 2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 - 3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
 - e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.

- i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
- 4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1. 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scale and external zero adjustment.
 - 1. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
 - 2. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for feeder circuits, unless otherwise indicated.
- D. Instrument Switches: Rotary type with off position.
 - 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and phase-to-neutral voltages where a neutral is included.
 - 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Watt-Hour Meters and Wattmeters:
 - 1. Comply with ANSI C12.1.
 - 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
 - 3. Suitable for connection to three- and four-wire circuits.
 - 4. Potential indicating lamps.
 - 5. Adjustments for light and full load, phase balance, and power factor.
 - 6. Four-dial clock register.
 - 7. Integral demand indicator.
 - 8. Contact devices to operate remote impulse-totalizing demand meter.
 - 9. Ratchets to prevent reverse rotation.
 - 10. Removable meter with drawout test plug.
 - 11. Semiflush mounted case with matching cover.
 - 12. Appropriate multiplier tag.
- F. Impulse-Totalizing Demand Meter:
 - 1. Comply with ANSI C12.1.
 - 2. Suitable for use with MCC watt-hour meter, including two-circuit totalizing relay.
 - 3. Cyclometer.
 - 4. Four-dial, totalizing kilowatt-hour register.
 - 5. Positive chart drive mechanism.
 - 6. Capillary pen holding a minimum of one month's ink supply.
 - 7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
 - 8. Capable of indicating and recording 30-minute integrated demand of totalized system.

- G. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

2.11 FEEDER TAP UNITS

- A. MCCBs (to 1200 A): Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
3. Communication Capability: Din-rail-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
4. With built-in digital ammeter and a digital display, showing tripping cause.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One 2-NC and 2-NO contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
11. Electrical Operator: Remote control for on, off, and reset operations.

- B. Fusible Switches (to 600 A): Fixed-mounted, manually operated, electrically tripped, fusible, quick-make, quick-break switch with 200-kA interrupting and short-circuit current rating when fitted with UL 248-8 Class J fuses. Comply with UL 98.

1. Indication whether the switch is open or closed, and provisions for padlocking the operating handle.
2. Include fuse clips and fuses.
3. Electrically tripped switches shall include the following:
 - a. Shunt trip.
 - b. Ground-fault protection, with adjustable time delay and test panel.
 - c. Single-phase protection, tripping the switch on loss of a source phase.

- d. Blown fuse protection, tripping the switch on a blown fuse, with blown fuse indication.

2.12 PANELBOARDS

- A. Comply with NEMA PB 1.
- B. Branch OCPDs for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- C. Branch OCPDs for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
- E. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.13 TRANSFORMERS

- A. Factory-assembled and -tested, air-cooled, two-winding, low-voltage dry-type transformers; with primary circuit breaker. Comply with NEMA ST 20.
- B. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
- C. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- D. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- E. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- F. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.

2.14 SOURCE QUALITY CONTROL

- A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.
- B. VFC Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to its specified motor.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

- C. MCCs will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.
- B. Floor Mounting: Install MCCs on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible switch.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

- I. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
 - 1. Identify field-installed conductors, interconnecting wiring, and components.
 - 2. Install required warning signs.
 - 3. Label MCC and each cubicle with engraved nameplate.
 - 4. Label each enclosure-mounted control and pilot device.
 - 5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.
- B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's BAS and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

- A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Submit calibration record for device.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - 6. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.
- F. MCCs will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

3.8 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.
- B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 50 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.
- F. Program microprocessors in VFCs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- G. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

END OF SECTION