SECTION 26 11 13.11
PACKAGED UNIT SUBSTATION

SECTION 16360-2A
COMPACT COMPARTMENTALIZED MEDIUM VOLTAGE METAL-ENCLOSED LOAD INTERRUPTER SWITCHGEAR – HVL/CC

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Medium Voltage compact compartmentalized metal-enclosed switchgear with load interrupter switches.

1.02 REFERENCES
A. ANSI / IEEE C37.20.3 (19--) – Standard for Metal Enclosed Interrupter Switchgear.
E. NEMA
F. CAN/CSA C22.2 No. 31 Switchgear Assemblies.
G. CAN/CSA C22.2 No. 193 High Voltage Full Load Interrupter Switches.

1.03 SUBMITTALS
A. Metal-enclosed switchgear assembly shall be in accordance with the contract documents, acceptable codes and whichever is the most stringent.
B. The manufacturer shall furnish a detailed Bill of Material and complete set of drawings including:
   1. Detailed front elevation
   2. Single Line
   3. Floor Plans
   4. Schematics
   5. Wiring Diagrams
C. The manufacturer shall furnish comprehensive instruction manuals covering the installation of the switchgear and the operation of its various components.

1.04 QUALITY ASSURANCE
A. In accordance with (customer to specify section)
B. Manufacture: Company specializing in medium voltage metal-enclosed switchgear with at least five years documented experience. The manufacturer of the switchgear must be the same as the manufacturer of the load interrupter switch.
C. Equipment shall be UL (cUL) listed and labeled for metal-enclosed type switchgear.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site under provisions of section 01650.
B. Store and protect products under provisions of Section 01660.
C. Accept equipment on site and inspect for shipping damage.
D. Protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer’s instructions.

PART 2 PRODUCT

2.01 MANUFACTURERS
A. Switchgear: The metal-enclosed load interrupter switchgear shall be Square D type HVL/cc or approved equal. Submit shop drawings under the provisions of Section 01330.
B. Current limiting fuses shall be Square D din style or equal for [4.76kV] [15.5kV] voltage class (note: fuse size on one-line diagram). Fuses shall have a 65,000 amperes symmetrical interrupting capability at [4.76kV] [15.5kV] [17.5kV].

2.02 LOAD INTERRUPTER SWITCHGEAR ASSEMBLY
A. The metal-enclosed switchgear assembly shall be compartmentalized into the following distinct compartments:
   1. Main bus compartment
   2. Switch Compartment
   3. Cable connection / fuse compartment
   4. Mechanism compartment
   5. [Optional] Low voltage / control compartment.
B. The metal-enclosed switchgear with load interrupter switches shall consist of a close coupled connection with the transformer and be of indoor construction. The section shall contain the load-interrupter switch and the necessary accessory components. The equipment shall be factory-assembled (except for necessary shipping splits) and operationally checked. The assembly shall be a self-supporting, floor mounted bay [and shall be securely bolted to the transformer to form an integrated structure.] Each incoming bay shall be [14.75"W] + [11.25"W transition section required for Bottom Feed applications.]
C. The equipment shall be designed for [front and end transformer accessibility only].
D. Cable entry shall be [top] [bottom (11.25"W transition section required for Bottom Feed applications).]
E. The complete assembly shall be constructed in accordance with applicable provisions of ANSI / IEEE C37.20.3-1987 and the minimum construction standards of the manufacturers of the major components such as power fuses or potential transformers. Provide adequate space for fuse handling when applicable. In establishing the requirements for the enclosure design, consideration shall be given to such relevant factors as controlled access, tamper resistance and protection from ingress of rodents and insects.
F. Switchgear rated 600 amps continuous shall not require ventilation openings to aid in cooling of the associated components.
G. The integrated fused switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.
H. The switchgear shall be low maintenance designed to reduce the requirements for annual/periodic maintenance of the equipment. Equipment with scheduled maintenance intervals of 5 or more years is preferred.
I. Two viewing ports shall be installed in the switch enclosure to enable visual verification of the switch blade operation.
J. An animated mimic bus attached to the end of the operating shaft shall be provided to give visual indication of the position of the switch.

K. System Voltage: [ ] kV (15.5kV Max.), three phase, [solidly grounded] [resistor grounded through a [ ] ohm resistor] [ungrounded], [three phase 3 wire] [three phase 4 wire].

L. Operating Frequency: 60Hz.

M. Maximum Short Circuit Current: 25kA RMS Symmetrical.

N. Maximum Design Voltage: [5.5] [15.5] [17.5] kV.

O. Basic Impulse Level (BIL): [60] [95] kV.

P. Power Frequency Withstand: [19] [36] kV.

Q. Short-Time Current (two second): Interrupter switch 25kA
   Grounding switch 25kA

R. Integrated Short Circuit Rating: [25 kA] [38 kA] [50 kA] [65 kA], RMS symmetrical

2.03 COMPONENTS

A. [Over Center Mechanism]
   The load interrupter switch, rated 600 amperes continuous and interrupting, shall be fixed mounted [manually] operated, and shall be quick-make, quick break with the speed of operation dependent on the operator. The grounding switch, on closing, shall be quick-make with the speed of operation independent of the operator.

   To provide for dependable operation, the device shall not rely on chains or cables to drive the blade assemblies open and closed. The operating mechanism shall be isolated from high voltage by a steel barrier and coupled through a direct drive shaft. Access to mechanism parts shall not require de-energizing of the equipment.

2.04 ACCESSORIES

A. Provide a grounding switch on the load side of the fuses to discharge any capacitive voltage in the feeder cable prior to gaining access to the fuse compartment. Switch shall be mechanically interlocked with the main grounding switch of the load interrupter switch.

B. Surge Arresters: metal-oxide type: Distribution class, rated [ ] [18] kV, MCOV; one per phase.

C. Incoming Cable Termination: An anti-rotational mounting pad shall have provisions for [1] [2] single hole cable lugs.

D. Provide [compression lugs] [mechanical lugs] for terminating cables onto the switchgear terminal pads.

E. Provide [optional] low voltage compartment to accommodate control circuit terminal blocks {and PowerLogic metering} { Model 98 Digital Temperature Controller }. The low voltage/instrument compartment door shall be hinged.

F. Provide two 2” [optional] [short-wave] [long-wave] infrared inspection windows per vertical section. One window shall be for the lower compartment and the other for the upper compartment.

G. Anti-condensation space heaters [optional for indoor]: For [120] [240] VAC [supplied by user] [from control power transformer], sized by the manufacturer, with [thermostats] [humidistat].

H. Pad lock provisions for mechanism covers on the load interrupter switch and grounding switch mechanisms shall be supplied as standard to prevent unauthorized access to the operating mechanism.

I. Blown Fuse Indicator: with indicating flag [optional (1) Form C NO Contact ]

J. Mechanical Interlocks:
   1. An interlock shall be provided on the grounding switch mechanism to prevent insertion of the operating handle and operation of the grounding switch when the load interrupter switch is in the closed position. {Include when ground switch is specified}
   2. An interlock shall be provided on the load interrupter switch mechanism to prevent insertion of
the operating handle and operation of the load interrupter switch when the grounding switch is in the closed position.

3. An interlock shall be provided to prevent the removal of the high voltage access panel with the load interrupter switch closed.

4. To facilitate cable testing in the high voltage compartment, the grounding switch can be returned to the open position. In this position interlocks are to be provided to prevent replacement of the high voltage access panel and prevent closure of the load interrupter switch. [Include when ground switch is specified]

K. Key Interlocks: [Schneider Locks]

L. Metering Options:
   Bay containing load interrupter switch shall include the following [as shown on the drawings]:
   1. PowerLogic Circuit Monitor (CM-4000 only), [with digital display] [with waveform capture]
      [stand-alone]
      Wired for communications to other [devices.]
   2. PowerLogic System Display, [with printer port]
   3. PowerLogic digital meter (PM-600 Series.)

2.05 FABRICATION
A. Construction: Indoor Only. Equipment bay shall be a separately constructed cubicle assembled to form a rigid free standing unit. Minimum sheet metal thickness shall be 11 gauge steel on all exterior surfaces. Unit shall be braced to prevent distortion.

B. Torque bolts that are used for insulators and direct support of any current carrying parts shall be marked with a bead of highly visible bright orange “torque seal”, that will readily show when a bolt has loosened.

C. The high voltage non-disconnect type fuses (when required), shall be accessible only through a separate panel mechanically interlocked with the switch. [Where grounding switches are supplied, access panels shall not be removable unless the grounding switch is in the closed position.] [If grounding switches are defeated, access panels shall not be removable unless the load interrupter switch is in the fully open position.] Screened or penetrable barriers which may allow intentional or inadvertent contact with energized parts shall not be permitted.

D. Height shall be 90”, 15kV maximum, single, indoor switch.

2.06 FACTORY FINISHING

A. All non-painted steel parts shall be zinc plated.

B. All painted steel parts shall be cleaned and a iron-phosphate pre-treatment applied prior to paint application.

C. Paint Color shall be ANSI 49 (light gray) or ANSI 61 (dark gray) TGIC polyester powder, applied electrostatically through air. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 2.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.

D. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.3-1987. Salt spray withstand tests in accordance with paragraph 5.2.8.4 shall be performed on a periodic basis to provide conformance to this corrosion resistance standard of at least 600 hours minimum.
PART 3 EXECUTION

The following paragraphs in this section represent work that is to be performed by the installing Contractor.

3.01 EXAMINATION
A. Visually inspect switchgear for evidence of damage and verify that surfaces are ready to receive work.
B. Visually inspect to confirm that all items and accessories are in accordance with specifications and drawings.
C. Verify field measurements are as [shown on Drawings] [shown on Shop Drawings] [instructed by manufacturer.]
D. Verify that required utilities are available, in proper location, and ready for use.
E. Beginning of installation means installer accepts existing surface conditions.

3.02 INSTALLATION
A. Install in accordance with manufacturer’s instructions, applicable requirements of the NEC and in accordance with recognized industry practices.
B. [Connect the primary surge arresters if not connected. If required, use jumper cables, as provided by the switchgear manufacturer.]
C. Bending of high-voltage cables should be avoided or minimized. All necessary bends should meet at least the minimum radii specified by the cable manufacturer.

3.03 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed by [the installing contractor] [a separate contractor furnished by the owner] under provisions of Section 01400.
B. Visually inspect switchgear for physical damage upon receipt.
C. Perform mechanical operator tests in accordance with manufacturer’s instructions.
D. Check torque of all bolted connections, including cable terminations, either by observing the bead of indicating compound to confirm that it is still intact, or with a torque wrench to confirm the joint is tightened to the manufacturer’s specifications.
E. Touch-up all chips and scratches with manufacturer-supplied paint and leave remaining paint with Owner.
F. Verify key lock interlock operation is applicable.
G. Perform insulation resistance test on each phase to ground and phase to phase. Record results for future reference.
H. Perform low-frequency withstand tests according to ANSI/IEEE C37.20.3, paragraph 5.5.
I. Perform contact resistance test across each switch blade; report any contact resistance in excess of 50 micro-ohms.

SECTION 16360-2B
MEDIUM VOLTAGE METAL-ENCLOSED LOAD INTERRUPTER SWITCHGEAR (Air Interrupter Switches) – HVL Switch

This specification is written for 5 kV through 15 kV close-coupled metal-enclosed switchgear with load interrupter switches for PowerZone Model III Packaged Unit Substations.

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Medium voltage metal-enclosed switchgear with air load interrupter switches.

1.02 REFERENCES
A. ANSI/IEEE C37.20.3 - Standard for Metal-Enclosed Interrupter Switchgear.
B. ANSI/IEEE C37.20.4 - Standard for Indoor AC Medium Voltage Switches used in Metal-Enclosed Switchgear.
C. NEMA

1.03 SUBMITTALS
A. The metal-enclosed switchgear assembly shall be in accordance with the contract documents, applicable codes whichever is the most stringent.
B. The manufacturer shall furnish a detailed Bill of Material and complete set of drawings.
C. The manufacturer shall furnish comprehensive instruction manuals.

1.04 QUALITY ASSURANCE
A. Manufacturer: The manufacturer of the switchgear must be the same as the manufacturer of the load interrupter switch, transformer and distribution section.

1.05 DELIVERY, STORAGE, AND HANDLING
The following paragraphs apply only to the installing contractor.
A. Accept equipment on site and inspect for shipping damage.
B. Protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCT

2.01 MANUFACTURERS
A. Switchgear: The metal-enclosed load interrupter switchgear shall be Square D type HVL or approved equal.

2.02 LOAD INTERRUPTER SWITCHGEAR ASSEMBLY
A. The metal-enclosed switchgear with load interrupter switches shall consist of a single section line-up, and be of indoor type construction. The section shall contain the load interrupter switches and the necessary accessory components. The equipment shall be factory-assembled and operationally checked. The assembly shall be a self-supporting, floor mounted bay and shall be securely bolted to the transformer and I-LINE distribution section to form an integrated structure.
B. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.
C. A viewing window shall be installed in the switch enclosure and located so as to enable visible inspection of the switch blades from outside the enclosure.
D. System Voltage: [5] [15] kV, 3-phase, [solidly grounded] [resistor grounded through a [___] ohm resistor] [ungrounded], [3-phase, 3-wire] [3-phase, 4-wire] with [without] neutral bus.
E. Operating Frequency: [50] [60] Hz. Maximum Short Circuit Current: [20, 40] kA RMS symmetrical.
F. Maximum Short Circuit Current: [25] kA rms symmetrical.
G. Maximum Design Voltage: [5.0] [15.0] kV.
H. Basic Impulse Level (BIL): [60] [95] kV.
I. Power Frequency Withstand: [19] [36] kV.
K. Ampacity: [600] amps, continuous.
L. Integrated Short Circuit Rating: [50] [65] kA, RMS symmetrical.

2.03 COMPONENTS
A. Load Interrupter Switch (Select 1 or 2)
   [Over-Center Mechanism]
   The load interrupter switch shall be rated at [600] amperes continuous and interrupting; fixed
   mounted on [glass reinforced polyester] [porcelain] standoff insulators; [manually] operated.
B. Switches shall utilize main current carrying paths and arcing interruption path type poles.
C. The switch operating handle shall be permanently attached to the outside front of the switchgear and
   ready for immediate use The handle must operate in the conventional fashion with the switch closed
   with the handle in the up position and the switch open with the handle in the down position.
   Provisions shall be available for padlocking the switch in either the open or closed position.
D. Voltage and Short Circuit Ratings: Match ratings specified for assembly.
E. Momentary Rating: [40] [61] kA, rms asymmetrical.
F. Fault Closing: [40] kA, rms asymmetrical.

2.04 ACCESSORIES
A. Surge Arresters (metal-oxide type): [Distribution] class, rated [_____] kV, [_____] MCOV; one per
   phase.
B. Incoming Cable Termination: [Cable Lug].
C. Provide [double clamping lugs ] [compression lugs] [mechanical lugs] for terminating cables onto the
   switchgear terminal pads.
D. Space Heaters: For [120] [240] VAC external source, sized by the manufacturer, with [thermostats]
   [humidistat].
E. Mechanical Interlocks: The high-voltage compartment door shall be interlocked to prevent opening
   with the load interrupter in the closed position.
F. Key Interlocks: [______]

2.05 FABRICATION
A. Construction: [Indoor.] Each equipment bay shall be a separately constructed cubicle assembled to
   form a rigid unit intended for close coupling to transformer and I-LINE distribution section. Minimum
   sheet metal thickness shall be 11 gauge steel on all exterior surfaces. Each individual unit shall be
   braced to prevent distortion.
B. A viewing window shall be installed in a fixed panel of the enclosure to enable visual inspection of the
   disconnect blades from outside the enclosure.
C. The high voltage fuses (when required) and non-disconnect type fuse mountings, shall be accessible
   only through a separate door mechanically interlocked with the load interrupter switch, so the load
   interrupter switch is opened before the door is opened and that the switch cannot be closed when the
   door is open.
D. Switch shall be [silver-plated copper] [tin-plated copper], rated [600] amps, and is to be supported on
E. Bay shall include a ground pad with lug.

2.06 FACTORY FINISHING
A. All steel parts are shot blasted to near white metal (SP10) prior to paint application. Paint finish
   consists of a two-part polyurethane and is applied to one mil nominal thickness.
B. Paint color shall be [ANSI-61 (light gray); ANSI-49 (medium light gray)] Paint film shall be uniform
   in color and free from blisters, sags, flaking and peeling.

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Power-Dry (VPI) dry-type transformers - Vacuum-pressure impregnated (VPI) transformers are particularly suited for a wide range of commercial applications. Vacuum pressure impregnation of the windings includes a preheat, dry vacuum cycle; vacuum immersion; vacuum hold cycle; pressure cycle; and curing. This VPI process saturates the dielectric material, which contributes to its long life and durability. The secondary is sheet wound and employs Nomex(r) insulation. The primary is barrel wound over the secondary winding.

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power-Dry substation transformers.

1.02 REFERENCES

A. IEEE C57.12.01 - Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those With Solid Cast and/or Resin-Encapsulated Windings.
B. ANSI C57.12.10-1988, Safety Requirements 230 kV and Below 833/958 Through 8333/10 417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Changing; and 3750/4687 Through 60 000/80 000/100 000 kVA with Load Tap Changing.
C. ANSI C57.12.28 - Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity.
D. ANSI C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers, 1-500 kVA Single-Phase and 15-500 kVA Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 120-600 Volts.
E. ANSI C57.12.51 - Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and Larger Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 208Y/120-4160 Volts.
F. ANSI C57.12.55-1987, Conformance Standard for Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations.
L. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers.
M. IEEE C57.94-1982 (Reaff 1987) - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers.
N. IEEE C57.96-1989 - Guide for Loading Dry-Type Distribution and Power Transformers (ANSI).
Q. CSA-C88 - Power Transformers and Reactors.

1.03 SUBMITTALS

A. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.
B. Submit product data indicating standard model design tests and options.
C. Submit manufacturer's installation instructions.

1.04 OPERATION AND MAINTENANCE DATA

A. Include procedures for cleaning unit, and replacing components.
A. Manufacturer: Company specializing in distribution transformers with [three] [ ] years [documented] experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Protect dry-type transformers from moisture by using appropriate heaters as instructed by the manufacturer.

PART 2 PRODUCT
2.01 MANUFACTURERS
A. Square D Company [no equal] [or approved equal].

2.02 POWER-DRY (VPI) SUBSTATION TRANSFORMERS
A. Transformer primary termination shall be close coupled to switchgear on left or right. Secondary termination shall be located on front of transformer. 

B. Primary terminations shall be designed for close coupling to a [HVL] [HVL/cc] switch section. Secondary terminations shall be designed for close coupling to [I-LINE distribution section] [Vertically mounted Thermal Magnetic Circuit Breaker] to be oriented in front of transformer.

C. Orientation shall be primary on the [left] [right] when facing PowerZone Model III front.

D. The transformer(s) shall be rated [75, 112.5, 225, 500, 750,1000kVA] [kVA AA] [/kVA AA/FFA] [/kVA AA/FA]. Primary voltage [2.4, 5, or 15kV] delta. Secondary voltage [208, 480] volts [wye] [240, 600] volts [delta], [3-wire] [4-wire], 60 Hz with two 2-1/2% full-capacity above normal and two 2-1/2% full-capacity below normal primary taps. Impedance shall be [%] [manufacturer's standard impedance], ±7-1/2%. All transformers shall have an average temperature rise of [150° C] [115° C] [80° C], [1000kVA = 150° C Only] above a 40° C maximum, 30° C average ambient.

E. The primary basic impulse levels (BIL) shall be a maximum of [60 kV for the 15 kV class] [30 kV for the 5 kV class] [10 kV for the 1.2 kV class].

F. The coil design shall be the type to provide the most efficient, reliable, and compact winding. Transformer coils shall be of the continuous wound construction and impregnated utilizing the VPI process, achieving 100% impregnation in one cycle. The coils shall be subjected to a dry vacuum of no less than 29.7 inches of mercury. Precatalyzed, 100% reactive-type polyester resin shall be introduced into the coil with vacuum maintained during the process. The coils shall then be subjected to a pressure of 75 psi for a suitable length of time to provide complete impregnation of the coils with no voids or air pockets that can create hot spots or cause corona formation. The coils shall then be cured in ovens with a minimum 2 mils coating over all Nomex insulated conductors.

G. The coils shall be wound with [aluminum] [copper] conductors.

H. All insulating materials are to be in accordance with IEEE Standard C57.12.01 for 220° C UL insulation system.

I. All cores to be constructed of high grade, grain-oriented, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. Core lamination shall be miter cut at the core corners to reduce hot spots, core loss, excitation current, and sound level. The laminations shall be clamped together utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core.

J. The transformer enclosures shall be ventilated, indoor only, and fabricated of heavy gauge, sheet steel construction. Enclosures are to be provided with lifting devices bolted or welded to the base structure and shall have jacking pads designed to be flush with the enclosure. The base is to be constructed of structural steel members to permit skidding or rolling in any direction. Provisions shall be made to completely isolate the core and coil from the enclosure. There shall be no metal-to-metal contact. Rubber vibration isolation pads shall be installed by the manufacturer between the core and coil and the enclosure. The core shall be visibly grounded to the ground bus or ground pad by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.

K. The paint color shall be [ANSI 49] [ANSI 61].

L. Transformer sound levels shall be warranted by the manufacturer not to exceed the following values: 75 to 150 kVA 58 dB, 151 to 300 kVA 58 dB, 300 kVA 58 dB, 500 kVA 50 dB, 501 to 700 kVA 64 dB, 701 to 1000 kVA 64 dB.
M. Fan cooling equipment shall include 3-phase Model 98 Digital Temperature Monitor controlled automatically by a Type K thermocouple placed in the low voltage air duct. The temperature monitor must contain green, yellow, and red indicating lights. The green lamp indicates power, while the yellow and red lamps signal that fan and alarm contacts have been activated. Alarm contacts shall be provided for fans, alarm, and trip function. An audible alarm must sound when the highest phase temperature exceeds a preset point. The fans must be able to operate in either manual or automatic mode. Fans must have a minimum 6 inch diameter blade and shall be controlled automatically by the sensor in the low voltage air duct. Forced air cooling system shall include: fans, control wiring, controller with test switch, current limiting fuses in the power supply to the controller, indications lights, alarm silencing relay, auto/manual switch, and necessary accessories to properly control the system.

N. Testing - Tests shall be conducted in accordance with the provisions of IEEE C57.12.91 and shall include, as a minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. Impulse Test (typical data from previous unit is acceptable)
11. Temperature Test (typical data from previous unit is acceptable)
12. Sound Test (typical data from previous unit is acceptable)

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that [pads] [poles] are ready to receive work.
B. Verify field measurements are as [shown on drawings.] [instructed by manufacturer.]
C. Verify that required utilities are available, in proper location and ready for use.
D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION
A. Install in accordance with manufacturer’s instructions.
B. Install safety labels to NEMA 260.

3.03 FIELD QUALITY CONTROL
A. Test dielectric liquid to ASTM D877, using 25,000 volts minimum breakdown voltage, after installation and before energization from system.
B. Test transformer to ANSI/IEEE C57.12.90.
C. Test transformer to ANSI/IEEE C57.12.91.
The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

A. NEMA PB 1 - Panelboards
B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
C. NEMA AB 1 - Molded Case Circuit Breakers
D. UL 50 - Enclosures for Electrical Equipment
E. UL 67 - Panelboards
F. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
G. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
H. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
I. Federal Specification W-P-115C - Type I Class 1
K. Federal Specification W-C-865C - Fusible Switches
L. NFPA 70 - National Electrical Code (NEC)
M. ASTM - American Society of Testing Materials

1.03 SUBMITTAL AND RECORD DOCUMENTATION
A. Approval documents shall include drawings. Drawings shall contain overall distribution section panelboard dimensions, interior mounting height dimensions and wiring gutter dimensions. Location of main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

1.04 QUALIFICATIONS
A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
B. Panelboards shall be manufactured in accordance with standards listed Article 1.02 - REFERENCES.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Inspect and report concealed damage to carrier within their required time period.
B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.06 OPERATIONS AND MAINTENANCE MATERIALS
A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.07 WARRANTY
A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

1.08 RELATED WORK
A. Section 16440-9 - Remote Controlled Lighting Panelboard System
B. Section 16280 – Transient Voltage Surge Suppression

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Shall be Square D Company I-LINE – Class 2110, Catalog # HCR5486-12U.
B. Substitutions must be submitted in writing three weeks prior to original bid date with supporting documentation demonstrating that the alternate manufacturer meets all aspects of the specification herein.

2.02 POWER DISTRIBUTION PANELBOARDS
A. I-LINE Circuit Breaker Distribution Panelboard
   1. Interior
      a. Shall be Square D I-LINE type rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated [schedules] [drawings] not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests.
conducted in accordance with UL 67.

b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated [schedules] [drawings] not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 rms symmetrical amperes. Main lug only panelboards shall be suitable for use as Service Entrance Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G. Panelboard can be used as Main Breaker type when equipped with back-fed main mounted plug-on with mechanical restraint on a common pan / rail assembly.

c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

d. The bussing shall be fully rated with sequentially phased branch distribution. Copper Bussing shall be rated 1200A and shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel mounting pan fasteners.

e. Interior trim shall be of dead-front construction to shield user from all energized parts.

f. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided.

g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.

h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

2. Group mounted circuit breakers through 1200A

a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

c. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

d. Line-side circuit breaker connections are to be jaw type.

e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

(Select Electronic trip 100%, Electronic trip 80% or Thermal Magnetic)

3. [Electronic trip molded case full function 100% rated circuit breakers]

a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, [Short Time Pickup], [Short Time Delay], [Ground Fault Pickup] [Ground Fault Delay] and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

b. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13\textsuperscript{th}) harmonic. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].

c. Local visual trip indication for overload, short circuit and ground fault trip occurrences.

d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

e. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.

f. Circuit breaker shall be provided with Zone selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on [schedules] [drawings]
g. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

3. [Electronic trip molded case standard function 80% rated circuit breakers]
   a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
   b. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule/drawing.
   c. Local visual trip indication for overload, short circuit and ground fault trip occurrences
   d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
   e. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

4. [Thermal magnetic molded case circuit breakers]
   a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
   b. Circuit protective devices shall be Square D molded case circuit breakers. Circuit breakers shall be standard interrupting [high interrupting] [extra high interrupting] [true current limiting*]. Ampere ratings shall be as shown on the drawings.
      * Manufacturer shall submit one set of published Ip and I²t let-through curves (as required by UL) to the owner.

5. Enclosures
   a. Type 1 Boxes
      1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvannealed steel will not be acceptable.
      2) Boxes shall have interior mounting channel. Interior support bracket shall be provided for ease of interior installation.
      3) Maximum enclosure dimensions shall be 42” wide (500kVA: 80 and 115 Deg. C Rise, all 750kVA and 1000kVA shall be 60” wide.) and 10.0” deep.
   b. Type 1 Trim Fronts
      1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
      2) Trim front shall be [4-piece surface without door] available in [surface] mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory card holder shall be provided.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

3.02 FIELD QUALITY CONTROL
   A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
   B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
   C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION