

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****Table of Contents**

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MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear**

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

1. Foreword

1.1 Scope

This standard covers general requirements for 27 kV metal-enclosed interrupter (MEI) switchgear assemblies containing, but not limited to, such devices as interrupter switches; selector switches; power fuses; control, instrumentation and metering devices; and protective equipment for the control and protection of apparatus used for distribution of electrical power.

This standard is applicable only to metal-enclosed interrupter (MEI) switchgear ultimately owned by Seattle City Light.

Metal-enclosed interrupter (MEI) switchgear is intended for use on a 26.4 kV, three-phase, 60 Hz, 4-wire, solidly grounded, isolated neutral distribution system.

In addition to addressing the purely technical aspects of metal-enclosed (MEI) switchgear, this material standard may also be used by the Purchaser as a guide to:

- Develop site-specific requirements
- Assemble bid packages
- Aggregate bid information

Detailed, site-specific requirements shall be according to:

- Site-Specific One Line Diagram
- Site-Specific Requirements (text-based)

Purchaser is directed to **Appendix A** for information related to developing site-specific requirements.

This standard is not applicable to switchgear assemblies containing power circuit breakers, also known as metal-clad switchgear.

1.2 Standards

Metal-enclosed interrupter (MEI) switchgear assembly and components shall meet the requirements of the following standards and codes:

- 6801.4 - City Light Material Standard, 21 kV Heavy Duty Distribution Class Metal-Oxide Surge Arrester, dated October 18, 2004
- C37.20.3-2001 - IEEE Standard for Metal-Enclosed Interrupter Switchgear
- C37.20.4-2001 - IEEE Standard for Indoor AC Switches (1kV-38kV) for Use in Metal-Enclosed Switchgear
- C37.40-2003 - IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- ANSI C37.22-1997 - Preferred Ratings and Related Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear
- C57.12.28-1999 - ANSI Pad-Mounted Equipment-Enclosure Integrity
- C2-2002 - National Electric Safety Code (NESC)
- NEMA 250-2003 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- Revised Code of Washington (RCW) 19.29.010
- Q9001-2000 - ANSI/ISO/ASQ Quality Management Systems: Requirements

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****1.3 Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. Seattle City Light General Terms and Conditions
3. Site-specific one line diagram
4. Site-specific requirements
5. This Seattle City Light Material Standard
6. Other referenced Seattle City Light Material Standards
7. National and state codes
8. Industry standards

2. Ratings**2.1 Basic Electrical**

Switchgear shall have the following basic electrical ratings:

Maximum voltage	27 kV, rms
Number of phases	3-phase
Number of wires	4-wire, multi-grounded neutral
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	125 kV, crest
Power-frequency withstand voltage	60 kV, rms

2.2 Temperature Limitations

Switchgear components shall conform to the temperature limits set forth in the following industry standards:

Component	Standard
Insulating materials	IEEE C37.20.3, Section 5.5
Buses and connections	IEEE C37.20.3, Section 5.5
Surrounding air	IEEE C37.20.3, Section 5.5
Parts subject to contact by personnel	IEEE C37.20.3, Section 5.5
Switches	IEEE C37.20.4, Section 5.18
Fuse assemblies	IEEE C37.40, Table 1

3. Construction**3.1 General**

Service conditions shall be usual as defined in IEEE C37.20.3, Section 4.

General construction requirements shall be according to IEEE C37.20.3, Section 7.

Switchgear shall be outdoor rated.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****3.2 Arc Resistance**

Switchgear is not required to be arc-resistant according to the requirements of C37.20.7 – IEEE Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults

3.3 General Compartment Requirements

Compartments shall meet the following dimensional requirements:

Overall height	120 inches minimum
Overall width	60 inches minimum
Overall depth	48 inches minimum

Compartments shall meet the following electrical clearance requirements:

Bare energized bus to ground	7-1/2 inches minimum
Bare energized bus to bus	9 inches minimum
Bare energized bus to inside main compartment door	9 inches minimum
protective inner door	7-1/2 inches minimum

For the purpose of determining electrical clearances, assume outdoor terminations with three-inch diameter skirts will be used.

Viewing windows shall be provided according to the requirements of IEEE C37.20.3, Section 7.4.3 with the following clarifications:

- Elevation above the floor of the center of the viewing windows shall be between 48 and 66 inches. Exceptions to this requirement will be made for certain ancillary device compartments.
- When standing directly in front of the window (with compartment door closed) and looking in the direction of the visible break, viewing angle shall not exceed +/- 30 degrees off (horizontal) perpendicular.

Compartment doors shall be provided with a means to be fixed open.

Inside ceiling surfaces shall be coated with anti-condensation material.

3.4 Cable Termination Compartment Requirements

In addition to general compartment requirements, cable termination compartments shall meet the following requirements.

- Switchgear entrance bays shall be designed for bottom feed.
- Conduits shall be installed to turn up.
- Cable termination compartment shall meet the following dimensional requirements:
 - Distance from conduit end to middle phase termination landing pad shall be 60 inches minimum. Upon request and following agreement, Seattle City Light will provide a pit up to 2'-1" deep to obtain this minimum clearance.
- Each phase landing pad shall be provided with two sets of two 5/8-inch diameter holes on 1-3/4-inch vertical centers, each set separated horizontally 4-1/2 inches on center. Provide one additional 7/16-inch diameter hole per pad at least 1-3/4 inches away from the other holes for connecting surge arrester leads.
- A grounded base plate shall be provided inside the termination compartment, predrilled with three 7/16-inch diameter holes for mounting surge arresters. Surge arresters will be furnished and installed by Seattle City Light. Refer to City Light Material Standard 6801.4 / Stock Number 680117.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****3.4 Cable Termination Compartment Requirements, continued**

- A vertically mounted length of 1-5/8 inch by 1-5/8 inch strut channel shall be mounted on each side of the termination compartment. A third length of 1-5/8 inch by 1-5/8 inch strut channel shall be installed between the first two for mounting cable support hardware (provided by Seattle City Light).
- Because Seattle City Light owned switchgear does not contain a metering compartment, no EUSERC-related requirements are cited here. However, as a convenient reference for Seattle City Light engineers and large customers who may need to acquire their own switchgear, a review of Seattle City Light metering compartment requirements appears in **Appendix E**.

3.5 Nameplates

Switchgear assembly shall be provided with nameplates conforming to the requirements of IEEE C37.20.3, Section 7.4.1 with the clarification that the nameplates also include:

- Year of manufacturer
- Purchase Order Number

Nameplates shall be stainless steel and affixed to the switchgear with stainless steel fasteners.

3.6 Materials

Switchgear material requirements shall be according to IEEE C37.20.3, Section 7.5.1.

Material shall be steel.

3.7 Coating System Qualification

Coating system shall meet the qualification requirements of ANSI C57.12.28, Section 5 with the following clarifications:

- **Section 5.2.4** – Enclosure color

The topcoat color shall be Munsell 8.3 G6.10 / 0.54 (light gray).

- **Section 5.3** - Coating system test specimens

Reasonable dimensional variations of test specimens are acceptable.

- **Section 5.4.1** – Salt spray test

All test specimens shall be tested in the salt spray chamber for a period of:

- 1500 hours continuously for indoor rated MEI switchgear,
- 2500 hours continuously for outdoor rated MEI switchgear,

except for the short daily interruptions necessary to inspect the test specimen or replenish the solution in the reservoir.

- **Section 5.4.5** – Insulating fluid resistance test

The requirements of this section are waived.

3.8 Finish

Switch live parts, bus, and surfaces which are stainless steel, galvanized steel, glass, plastic viewing ports, porcelain, or which serve a dielectric purpose shall be left unpainted.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****3.9 Physical Access Control**

Each compartment containing high voltage components shall provided with the following:

- Protective inner door consisting of a solid, high-strength, transparent, full-length, hinged, bolted-closed barrier (Lexan, clear polycarbonate, or approve equivalent) inside each compartment main door in order to comply with Washington Administrative Code (WAC) 296-45-325, Table 1. Table 1 states for phase-to-phase voltages between 15.1 and 36.0 kV, the AC live work minimum approach distance shall be two feet ten inches.
- Padlockable door handle.
- Pentahead bolt.

3.10 Enclosure Category

Switchgear assembly enclosure category shall be B as defined in IEEE C37.20.3. Refer to Annex A.2 of IEEE C37.20.3 for category definitions.

3.11 Ventilation

Vents shall be provided at the top and bottom of the enclosure for air circulation.

Vents shall be equipped with filters to minimize dust and dirt ingress.

Vent filters shall be accessible from outside of the enclosure to allow the filters to be maintained without having to de-energize the switchgear.

Vents shall be designed to prevent the entrance of foreign objects.

3.12 Humidity Control

Each compartment shall be provided with an electric, strip-type, space heater to minimize condensation inside the compartment.

Space heater elements shall be enclosed within a perforated guard to protect against inadvertent contact.

Space heaters shall be wired to terminal blocks and protected with fuses or a separate circuit breaker.

Space heaters shall be controlled by a humidistat.

Space heater fuses (or circuit breaker) shall be accessible from outside high-voltage compartments.

Space heater power shall be provided by an internal source.

3.13 Convenience Outlets

Switchgear shall be provided with two 20 ampere ground-fault-interrupter (GFI) type convenience outlets.

Convenience outlets shall be located at the opposite ends of the switchgear.

3.14 Storage

Provision inside the transformer bay door shall be made for storing spare control and instrument transformer fuses.

3.15 Seismic Withstand Capability

Metal-enclosed switchgear shall be designed to avoid damage or loss of function and remain operational during and following an earthquake. The term "operational" means that rotating components will not freeze, pressure vessels will not rupture, supports will not collapse, systems required to be weatherproof will remain weatherproof, and components required to respond actively (such as control linkages, switch contacts, relays, motors, pumps, valves and similar items) will respond actively.

Equipment shall not change operational state due to the seismic event, that is, a device in the open position shall remain open; if closed, it shall remain in the closed position.

Zone 4 seismic requirements shall apply.

UBC Importance Factor shall be 1.25.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****4. Basic Components****4.1 Load Interrupter Switches**

Load interrupter switches shall be stationary mounted.

Load interrupter switches shall have the following ratings:

Maximum voltage	27 kV
Lightning-impulse withstand (BIL)	125 kV, crest
Power frequency withstand voltage	60 kV, rms
Power frequency	60 Hz

Load interrupter switches shall meet the electrical endurance capabilities of ANSI C37.22, Tables 3 with the following clarifications:

- Number of operations (under same conditions) shall be doubled.

Load interrupter switches shall meet the mechanical endurance capabilities of ANSI C37.22, Tables 4.

4.2 Load Interrupter Switch Operators

Load interrupter switch operator shall meet the applicable requirements of ANSI C37.22, Table 5.

4.3 Power Fuse Mountings

Power fuse mountings shall be as stated in site-specific requirements.

4.4 Power Fuses

Power fuses shall be as stated in site-specific requirements.

4.5 Insulators

Interrupter switch, fuse mounting, and bus support insulators shall be electrical grade, cycloaliphatic epoxy or wet porcelain type.

Insulators shall have:

- Successful operating history of at least 10 years in a similar application.
- Ablative action or inorganic glaze to ensure non-tracking properties.
- Adequate leakage distance established by test per IEC Publication 507, First Edition, 1975.
- Mechanical strength commensurate with the short circuit rating of the complete metal-enclosed (MEI) switchgear assembly.
- Lightning-impulse withstand (BIL) commensurate with the rating of the complete metal-enclosed (MEI) switchgear assembly.

4.6 Bus and Connections

Phase and neutral/ground bus shall be rectangular copper bar.

Phase and neutral/ground bus shall be bare.

Phase and neutral/ground bus system shall have a short circuit rating equal to that of the integrated assembly.

Neutral bus and the ground bus shall be one and the same.

A separate, insulated neutral bus is not desired and shall not be provided. Neutral/ground bus shall have a continuous current rating of 600 A.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****4.6 Bus and Connections, continued**

Neutral/ground bus shall extend the full length of the assembly.

Neutral/ground bus shall be bonded to the switchgear's frame and maintain electrical continuity throughout the integrated assembly.

Neutral/ground bus shall be connected to a two-hole grounding pad welded to the surface of the enclosure inside each vertical section.

Bus system joint connections shall be silver-plated.

Bus system joints shall utilize at least two bolts per connection.

Bus system shall not utilize braided conductor.

Cable termination bus shall be equipped with one-inch diameter ball-type grounding studs (one per phase plus neutral/ground), Salisbury catalog number 21191, to allow each phase to be safely checked for voltage with a hotstick-type voltage sensor and then grounded with hotstick-installed, ball and socket-type grounding system.

A hotstick-removable insulating cover, Salisbury catalog number 21236, shall be provided for each normally energized ball-type grounding stud.

Bay-to-bay bus transitions shall incorporate solid-type through bushings to prevent (in the event of a fault) the transmission of ionized gases to adjacent cubicles.

4.7 Surge Arresters

Surge arrester mounting points shall be provided inside the metal-enclosed switchgear cabinetry, where indicated on one line diagram.

Surge arresters shall be provided and installed by Seattle City Light.

Surge arresters shall meet the requirements of Seattle City Light Material Standard 6801.4, Stock Number 680117.

Surge arrester installation shall meet the requirements of NESC C2, Section 19.

4.8 Instrument Transformers

Current transformers shall meet the requirements of IEEE C37.20.3, Section 5.6.

If current transformers are required, ratings shall be as shown on the site-specific one-line diagram.

4.9 Auxiliary Power Transformer

Auxiliary power transformer shall have the following ratings:

Frequency:	60 Hz
Phase:	1
Voltage and taps	
HV:	25564 Grd Y / 14760 V
LV:	240/120 V
HV basic impulse insulation level (BIL):	125 kV, crest

Auxiliary power transformers' temperature rise above ambient shall not exceed 115 degrees C.

According to the requirements of the Revised Code of Washington (RCW), Section 19.29.010, Rule 5, auxiliary power transformer shall bear a tag that states:

- This transformer has been tested at rated line voltage and has successfully passed all applicable tests specified by ANSI and NEMA.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****4.9 Auxiliary Power Transformer, continued**

Tag shall include:

- Transformer serial number
- Date of test
- Name of person performing test

Auxiliary power transformer shall be protected by a primary, current-limiting fuse.

Auxiliary power transformer shall be sized to accommodate the maximum design load of the switchgear plus convenience outlets.

5. Protection and Control**5.1 Protection and Control**

Protection and control shall be as stated in site-specific requirements.

Purchaser is directed to **Appendix F** for information related to developing site-specific protection and control schemes.

5.2 Source Transfer

If source transfer control capability is required, it shall be accomplished by means of one of the following controllers:

- S&C Electric Company Micro-AT Source Transfer Control
- Schweitzer Engineering Laboratories SEL-351

Substitutions will not be considered.

5.3 Open-Phase Detector

If open phase detection is required, it shall be accomplished by means of one of the following devices:

- S&C Electric Company Open-Phase Detector – Type SPD
- S&C Electric Company Open-Phase Detector – Type ZSD
- Schweitzer Engineering Laboratories SEL-351

Substitutions will not be considered.

5.4 Pendant Switch Controller

Load interrupter switch operators shall be designed to accommodate a pendant-type controller for remote opening and closing of the load interrupter switch.

Pendant-type controller shall consist of a fifty-foot cable with an electrical connector on one end for plugging into the load interrupter switch operator and a watertight box on the other with push button-type control switches.

Each complete metal-enclosed interrupter (MEI) switchgear assembly containing at least one load interrupter switch operator shall be provided with two pendant-type controllers.

5.5 SCADA

SCADA capability shall be as stated in site-specific requirements.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****6. Alternative Construction**

Substitutions or alternative construction, which provides Seattle City Light with equal or better functionality, quality, strength, service life, or maintainability, will be considered and evaluated.

Bids incorporating substitutions shall include data that substantiates the proposed construction method or component has equal or better functionality, quality, strength, service life, or maintainability than the item specified.

Substitutions and alternative construction shall meet or exceed all cited standards and codes.

All proposed substitutions and alternative construction shall be summarized on **Appendix B – Bidder's Data Sheet**.

7. Special Tools

Each metal-enclosed interrupter assembly (MEI) shall be provided with at least one set of any special tools or equipment required to operator, maintain, inspect, and test the switchgear.

Special is defined as not usually on hand at an average electric utility, or important to be stored on-site, with the switchgear.

8. Testing and Certification**8.1 Quality Assurance**

Supplier shall adhere to ANSI/ASQ Q9001 to assure proper design, production, and testing of the complete metal-enclosed interrupter (MEI) assembly.

8.2 Design Tests

Design tests of the complete metal-enclosed interrupter (MEI) assembly shall be performed according to IEEE C37.20.3, Section 6.2.

Design tests of the individual load interrupter switches shall be performed according to IEEE C37.20.4, Section 6.2.

8.3 Production Tests

Production tests of the complete metal-enclosed interrupter (MEI) assembly shall be performed according to IEEE C37.20.3, Section 6.3.

Production tests of the individual load interrupter switches shall be performed according to IEEE C37.20.4, Section 6.3.

8.4 Conformance Tests

Conformance testing of the complete metal-enclosed interrupter (MEI) assembly is not required.

Conformance testing of individual load interrupter switches is not required.

8.5 Field Dielectric Tests

Field dielectric testing will be performed by Seattle City Light personnel.

9. Design Review

Seattle City Light reserves the right to have a representative(s) perform a technical review of the metal-enclosed (MEI) switchgear design prior to the design being released to manufacturing. Technical review, if performed, will be at the supplier's manufacturing facility. Seattle City Light will provide notification (at the time Approval Drawings are returned) as to whether such a review is desired.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****10. Test Witnessing**

Seattle City Light reserves the right to have a representative(s) present and observe production tests and/or inspect the metal-enclosed (MEI) switchgear prior to shipment. Photocopies of preliminary test results shall be supplied to Seattle City Light representative(s) witnessing the tests, upon request. Supplier shall provide Seattle City Light at least fourteen (14) days written notice prior to testing to allow Seattle City Light's representatives to be present at tests.

11. Documentation**11.1 General**

All documentation shall be in English and use customary inch-pound units.

11.2 Bidder's Information

Bidder shall furnish two (2) sets of the following information to Seattle City Light's Purchasing Department:

- Completed **Appendix B** – Bidder's Data Sheet
- The documents and drawings listed in **Appendix C** – Bidder Supplied Documents, Drawings, and Lists

Bid drawings and documents shall be marked with Seattle City Light's Request for Proposal (RFP) number.

11.3 Approval Drawings

Successful bidder/supplier shall furnish three (3) sets of the approval drawings and documents listed in **Appendix D** – Drawing and Documentation List (approval and final) to Seattle City Light's Purchasing Department.

Supplier's schedule shall include transmittal time and the twenty (20) working days Seattle City Light will require to conduct its review.

All approval drawings shall be endorsed for approval and be marked with Seattle City Light's purchase order number and supplier's shop order number.

Seattle City Light will review each drawing and document and return one (1) copy of each to the supplier together with a transmittal letter summarizing Seattle City Light's comments.

The transmittal letter will indicate the approval status of each drawing and document reviewed by Seattle City Light. Approval status categories are as follows:

ACCEPTED – WITHOUT COMMENT - Item is approved by SCL as to general scope and content; however, the supplier is not relieved of their obligation to meet all of the requirements of the Material Standard.

ACCEPTED – WITH COMMENTS NOTED - Item is approved by SCL as to general scope and content subject to the minor changes noted on the item; however, the supplier is not relieved of their obligation to meet all of the requirements of the Material Standard.

NOT ACCEPTED - REVISE AND RESUBMIT - Item is not approved by SCL. Supplier shall specifically address and/or incorporate all SCL comments into a revised submittal, and resubmit the item to SCL for approval.

Seattle City Light will review all revised and resubmitted drawings and documents and return one (1) copy of each, together with a transmittal letter, to the supplier within (10) working days after receipt. Drawings and documents shall bear a revised revision date. Revised areas of the submittal shall be circled.

Supplier shall present a complete and acceptable submittal package to Seattle City Light not later than the second submittal of an item.

Seattle City Light reserves the right to withhold monies due the supplier to cover the unplanned cost of review beyond the second submittal.

Corrections indicated on submittals returned by Seattle City Light shall be considered as changes necessary to meet the requirements of this material standard and shall not be taken as the basis for claims for extra work.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****11.4 Final Certified Drawings and Instruction Books**

After approval of all submittals by Seattle City Light, supplier shall furnish four (4) sets of the final, certified drawings, instruction books, spare parts list, and test reports listed in **Appendix D** – Drawing and Documentation List (approval and final) to Seattle City Light's Purchasing Department.

All final, certified drawings (etc.) shall be endorsed correct for construction and be marked with Seattle City Light's purchase order number and supplier's shop order number.

In addition to the above four (4) sets, one (1) set of drawings, instruction books, spare parts list, and test reports shall be shipped with one of the switchgear bays, suitably protected from shipping damage and weather.

12. Training**12.1 Operations and Maintenance**

Supplier shall provide **two** days of training, eight (8) hours each day, for up to 25 personnel covering the installation, operation, maintenance, troubleshooting and repair of the switchgear.

Supplier shall provide training within one (1) month of receipt of switchgear by Seattle City Light.

Supplier shall provide as course material certified drawings, instruction books, spare parts list, and test reports.

Supplier shall submit proposed course outline to Seattle City Light's Purchasing Department for review, comment, and approval four (4) weeks prior to shipping completed switchgear.

12.2 Engineering

Supplier shall provide **one** day of training, eight (8) hours each day, for up to 25 personnel covering the installation, operation, maintenance, troubleshooting and repair of the switchgear.

Engineering training will precede Operations and Maintenance training.

Supplier shall provide as course material certified drawings, instruction books, spare parts list, and test reports.

Supplier shall submit proposed course outline to Seattle City Light's Purchasing Department for review, comment and approval no later than two (2) months prior to shipping completed switchgear.

13. Warranty

Warranty general terms and conditions for metal-enclosed (MEI) switchgear shall be as specified in Seattle City Light's purchase order.

Warranty period for metal-enclosed (MEI) switchgear shall be a minimum of twelve (12) months from date of energization, or eighteen (18) months from date of receipt, whichever is earlier, or as stated on Seattle City Light's Request for Proposal or Purchase Order.

14. Shipping

Freight terms shall be FOB destination, freight prepaid and allowed, or as stated on Seattle City Light's Request for Proposal or Purchase Order.

Shipping destination shall be as specified on the site-specific requirements document or Seattle City Light's Request for Proposal or Purchase Order.

Exterior and interior of switchgear shall be received reasonably free from road dust, dirt, and other contamination. If it is necessary for Seattle City Light personnel to clean the switchgear, the supplier will be billed for their time.

Seattle City Light personnel will be responsible for rigging and off-loading metal-enclosed switchgear bay assemblies from delivery vehicles.

15. Approved Manufacturers

- Federal Pacific
- Powercon Corporation
- S&C Electric Company

As of October 2015, this standard has been renumbered from 2501.85 to 4505.85.

MATERIAL STANDARD

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

APPENDIX A - SITE-SPECIFIC REQUIREMENTS DEVELOPMENT WORKSHEET**A.1 Scope**

The purpose of this worksheet is to assist the Purchaser with the development of a set of detailed, site-specific requirements for a complete metal-enclosed interrupter (MEI) switchgear assembly.

The results of this work shall be:

- Site-Specific One Line Diagram, and a
- Site-Specific Requirements (text-based) Document

Each of the above shall be titled and dated so they can be easily referred to in the body of the Request for Proposal and (later) the Purchase Order.

A.2 General

Due to the variety of apparatus, enclosure, and control choices offered by industry and the countless bay variations mandated by the system this worksheet cannot be considered more than a guide. This worksheet does not and cannot cover all situations.

The Purchaser should be familiar with their system, switchgear accessibility, local environment, applicable national and state codes, and applicable industry standards.

The Purchaser should be aware that most manufacturers of metal-enclosed interrupter (MEI) switchgear are willing to offer (at no cost) informative product technical bulletins and technical advice.

Major metal-enclosed (MEI) switchgear design choices related to application include:

- Radial (single or multiple)
- Looped-primary
- Primary-selective (common bus or split bus)

Purchaser is directed to **Appendix F** for information related to developing site-specific protection and control schemes.

It is recommended that foundation construction work not proceed until after approved, metal-enclosed (MEI) switchgear base plan and anchor details are in hand.

A.3 One Line Diagram

One line diagram shall bear a project title, drawing number, revision number, and revision date.

One line diagram shall include at least the following information:

- Nominal system voltage
- Available (and future anticipated) line-to-line symmetrical short circuit current
- X/R ratio, if other than 15
- Maximum continuous main bus current
- Function of each bay (cable entrance, feeder, auxiliary, metering, or spare)
- Basic components contained in each bay (bus, interrupter switches, fuses, instrument transformers, surge arresters, meters, relays, etc.)
- Current transformer ratings (basic impulse level, rated primary and secondary currents, accuracy class, continuous thermal current rating factor)
- Interconnections of basic components
- Normally open and normally closed switch positions
- Bay designation numbers
- Each switch shall be identified as being manual or power-operated. If power operated, indicated if "stored energy" or "run and trip" type
- Point of service demarcation
- Conceptual foundation and conduit plan

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****A.4 Requirements (Text-Based)**

Site-specific requirements document shall bear a project title and revision date.

Site-specific requirements document shall include the following information:

- Constraints related to installation, for example, providing dimensions of a small entryway to the room where the switchgear will be installed.

Below is a list of design choices that are not normally addressed by the one line diagram. It is presented here for convenience.

- If switchgear will be exposed to unusual service conditions, state clarification. If no clarification is made, switchgear will be designed for usual service conditions. Refer to IEEE C37.20.3, Section 8 for guidance.
- If switchgear is required to be arc-resistant according to the latest revision of C37.20.7 – IEEE Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults, state clarification and indicate if:
 - Type 1 (front only) Accessibility or
 - Type 2 (front, back, and sides) Accessibility
- If no clarification is made, switchgear will **not** be designed to be arc-resistant.
- Indicate size and number per phase of primary, source cables.
- If switchgear neutral bus is to exist separately from the ground bus, state clarification. If no clarification is made, switchgear will be designed with a combined function neutral/ground bus.
- If switchgear is required to have other than bottom feed, state clarification. If no clarification is made, switchgear will be designed for bottom feed.
- If switchgear enclosure is required to be other than light gray, state clarification. If no clarification is made, switchgear enclosure will be light gray.
- If switchgear is required to be Enclosure Category A or C, state clarification. If no clarification is made, switchgear will be designed as Enclosure Category B. Refer to IEEE C37.20.3, Annex A.2 for category definitions.
- Minimum time for load interrupter switch to change state from closed to open and from open to close. This information gives insight into what kind of load interrupter operator is required.
- If a preference exists for switch operator control voltage, state clarification. Standard choices are 24, 48, 120, or 250 volts DC or 120, 240 volts AC single-phase, or 208Y/120 or 240 volts AC polyphase.
- If the complete metal-enclosed interrupter (MEI) switchgear assembly or individual load interrupter switches require conformance testing, state clarification. If no clarification is made, conformance testing will not be performed.

A.5 Shipping

Site-specific requirements document shall include:

- Facility name
- Shipping destination address
- Facility contact and phone number

The supplier (or carrier) shall notify Seattle City Light's facility contact a minimum of 48 hours before the shipment arrives at the destination site so that off-loading arrangements can be made.

A.6 Assembling the Bid Package

The Purchaser shall assemble the following documents (referenced to each other as indicated) into a bid package:

- I. Seattle City Light Request for Proposal
 - A. Site-specific one line diagram
 - B. Site-specific text-based requirements
 - C. This material standard
- II. Seattle City Light General Terms and Conditions

Bidder is responsible for obtaining copies of all other referenced and/or applicable codes and standards.

Seattle City Light material standards are available online. Refer to www.seattle.gov/light/engineerstd/.

MATERIAL STANDARD

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

APPENDIX B - BIDDER'S DATA SHEET

Seattle City Light Request for
Proposal (RFP) number

Respondent

Manufacturer Identification

Manufacturer's name, home office address,
contact, and phone number

Manufacturing plant address, contact, and phone
number (if different than above)

Number of years in business, successfully
manufacturing and delivering similar products

General

Unit price (\$)

Approval drawings (weeks after receipt of order)

Manufacture time (week after receipt approval)

Point of shipment

Method of shipment

Shipping time (time)

Total delivery time (weeks after receipt of order
including two weeks for Seattle City Light
approval review)

MATERIAL STANDARD

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27 kV Metal-Enclosed Interrupter (MEI) Switchgear

SUPERSEDING: December 22, 2005

EFFECTIVE DATE: October 29, 2015

Preventive Maintenance

Estimated labor hours and material cost for preventive maintenance tasks recommended by manufacturer to be performed during the first ten (10) years of service

Warranty

After receipt (months)

After energization (months)

Optional extended warranty, if any

After receipt (months / \$ adder)

After energization (months / \$ adder)

Manufacturer's Sales and Service Identification

Agency name, address, contact, and phone number of manufacturer's nearest sales office or representation

Agency name, address, contact, and phone number of manufacturer's nearest engineering field service office

All exceptions to Seattle City Light requirements shall be listed in summary form below with reference to the requirement to which an exception is taken. List shall include all proposed substitutions and cases of alternative construction.

MATERIAL STANDARD

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

STANDARD NUMBER: **4505.85**

PAGE: 18 of 23

SUPERSEDING: December 22, 2005

EFFECTIVE DATE: October 29, 2015

APPENDIX C – BIDDER SUPPLIED DOCUMENTS, DRAWINGS, AND LISTS

- C.1** Catalog literature
- C.2** Proposed switchgear assembly one line diagram
- C.3** Representative switchgear outline drawing showing:
- Individual bay dimensions
 - Basic components
 - Phase, neutral, and ground bus
 - Source cable training
 - Viewing windows
 - Weights
 - Base plan
 - Anchor details
 - Bill of material
- C.4** Clear indication if pit is required (and how deep) to obtain minimum clearances cited in Section 3.4 - Cable Termination Compartment Requirements.
- C.5** Representative wiring and schematic diagrams
- C.6** Ratings, technical summaries, make, and model of basic components, including, but not limited to:
- Load interrupter switches
 - Load interrupter switch operators
 - Fuse mountings
 - Insulators
 - Bus
 - Surge arresters
 - Instrument transformers
 - Control devices (hardware and software)
 - Wiring
- C.7** Representative bus connection (including bill of material)
- C.8** Design test data for the complete metal-enclosed interrupter (MEI) switchgear assembly as cited in IEEE C37.20.3, Section 6.2.
- C.9** Design test data for the load interrupter switches as cited in IEEE C37.20.4, Section 6.2.
- C.10** Seismic capability conformance documentation. This may be the product of physical testing or finite element analysis (FEA) software.
- C.11** Proof of QA/QC certification(s)
- C.12** Summary of factory QA/QC program
- C.13** Representative shipping, rigging, and off-loading delivery vehicle information
- C.14** Representative installation, operation, and maintenance manual(s)
- C.15** Summary descriptions (including estimated labor hours and material cost) for the preventive maintenance tasks the manufacturer recommends be performed during the first ten years of service.
- C.16** Warranty
- C.17** Extended warranty, if any
- C.18** List at least five projects completed within the last three years to supply 15 kV to 38 kV metal-enclosed (MEI) switchgear. List shall include:
- Project name
 - Customer name, address, and contact phone number
 - Equipment summary
 - Indoor or outdoor?
 - Number of bays
 - Arc resistant enclosure?
 - Voltage rating (kA)
 - Main bus rating (A)
 - Switch/fuse interrupting rating (MVA)
 - Relay description (hardware and software)
 - Year completed
 - Contract amount (\$)

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****APPENDIX D - DRAWING AND DOCUMENTATION LIST****For Approval**

- | | |
|--|--|
| D.1 Switchgear assembly one line diagram | D.5 Nameplate drawings |
| D.2 Switchgear outline drawing, showing: <ul style="list-style-type: none">▪ Individual bay dimensions▪ Basic components▪ Phase, neutral, and ground bus▪ Source cable training▪ Viewing windows▪ Weights▪ Base plan▪ Anchor details▪ Bill of material | D.6 Design test data for the complete metal-enclosed interrupter (MEI) switchgear assembly as cited in IEEE C37.20.3, Section 6.2. |
| D.3 Three line wiring, schematic, and logic diagrams | D.7 Design test data for the load interrupter switches as cited in IEEE C37.20.4, Section 6.2. |
| D.4 Ratings and technical summaries of basic components, including, but not limited to: <ul style="list-style-type: none">▪ Load interrupter switches▪ Load interrupter switch operators▪ Fuse mountings▪ Insulators▪ Bus and connectors▪ Surge arresters▪ Instrument transformers▪ Control devices (hardware and software)▪ Wiring | D.8 Current transformer ratio correction factor, phase angle, and excitation curves (typical) |
| | D.9 Step and touch potential analysis |
| | D.10 Seismic capability conformance documentation |
| | D.11 Installation, operation, and maintenance manual(s) |
| | D.12 Rigging diagrams for lifting and unloading switchgear |
| | D.13 Spare parts list including: <ul style="list-style-type: none">▪ Description of part▪ Catalog number▪ Unit price▪ Typical lead-time▪ Origin of stock▪ Recommended quantity |
| | D.14 Special tools required to operated, maintain, inspect, and test switchgear list |
| | D.15 Standard warranty |
| | D.16 Extended warranty, if any |

Final

- D.17** All of the items listed above (approved versions), plus
- D.18** Certified (production) test reports

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****APPENDIX E – SEATTLE CITY LIGHT METERING COMPARTMENT REQUIREMENTS****E.1 Scope**

The information presented in this appendix is applicable only to 27 kV metering compartments contained within customer-owned, metal-enclosed interrupter (or metal-clad) switchgear.

E.2 Basic Requirements

Metering compartment shall meet the requirements of the latest revision of:

- NFPA 70 (NEC)
- Electric Utility Service Equipment Requirements Committee (EUSERC) Section 400, Metering and Service Equipment

Note: Because EUSERC requirements are revised on an annual basis, be sure to refer to the latest revision.

In 2004, the applicable EUSERC drawing for enclosure requirements specific to 27 kV metal-enclosed interrupter (MEI) switchgear was:

- 401A – High Voltage Metering Enclosure 15001 to 27000 Volt Service, revision 2.

E.3 Seattle City Light Requirements

In addition to the above, Seattle City Light imposes further requirements:

- Distance from conduit end to middle phase termination landing pad shall be 60 inches minimum. Seattle City Light may provide a pit up to 2'-1" deep to obtain minimum clearance. This requirement supercedes EUSERC drawing 401A, revision 2, dated 12/03, sheet 2 of 2, 20800/27000 column, Dimension G, floor of compartment to phase landing pad.
- Distance from end of grounding ball to inside protective inner door shall be 12 inches minimum. This requirement supercedes EUSERC drawing 401A, revision 2, dated 12/03, sheet 2 of 2, 20800/27000 column, Dimension A.
- Conduits shall be installed to turn up.
- Three lifting eyes shall be provided to facilitate installation or replacement of metering current transformers.
- Neutral pad shall be insulated for phase to ground voltage passing between the termination compartment and the metering compartment. A copper pad predrilled with two sets of 9/16-inch diameter holes on 1-3/4-inch centers shall be provided inside the termination compartment.
- Bus shall be bare copper.
- Cable termination bus shall be equipped with one-inch diameter ball-type grounding studs (one per phase plus ground), Salisbury catalog number 21191, to allow each phase to be safely checked for voltage with a hotstick-type voltage sensor and then grounded with hotstick-installed, ball and socket-type grounding system.
- A hotstick-removable insulating cover, Salisbury catalog number 21236, shall be provided for each normally energized ball-type grounding stud.
- Each phase landing pad shall be provided with two sets of two 5/8-inch diameter holes on 1-3/4-inch vertical centers, each set separated horizontally 4-1/2-inch on center. Provide on additional 7/16-inch diameter hole per pad at least 1-3/4 inches away from the other holes for connecting surge arrester leads.
- A grounded base plate shall be provided inside the termination compartment, predrilled with three 7/16-inch diameter holes for mounting surge arresters. Surge arresters will be furnished and installed by Seattle City Light. Refer to City Light Material Standard 6801.4 / Stock Number 680117.
- A vertically mounted length of 1-5/8 inch by 1-5/8 inch strut channel shall be mounted on each side of the termination compartment. A third length of 1-5/8 inch by 1-5/8 inch strut channel shall be installed between the first two for mounting cable support hardware (provided by Seattle City Light).
- Protective inner door consisting of a solid, high-strength, transparent, full-length, hinged, bolted-closed barrier (Lexan, clear polycarbonate, or approve equivalent) inside each compartment main door in order to comply with Washington Administrative Code (WAC) 296-45-325, Table 1. Table 1 states for phase-to-phase voltages between 15.1 and 36.0 kV, the AC live work minimum approach distance shall be two feet ten inches.
- Compartment door handles shall be designed to accommodate a padlock shackle for physical access control.

MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****E.3 Seattle City Light Requirements, continued**

- Compartment doors shall be designed to accommodate a pentahead bolt for back-up physical access control.
- Inside ceiling surfaces shall be coated with anti-condensation material.
- Provide anti-condensation heater near floor.
- Vents shall be provided at the top and bottom of the enclosure for air circulation.
- Vents shall be equipped with filters to minimize dust and dirt ingress.
- Vent filters shall be accessible from outside of the enclosure to allow the filters to be maintained without having to de-energize the switchgear.
- Vents shall be designed to prevent the entrance of foreign objects.
- Compartment entrances shall be provided with rain shields.
- Seattle City Light will provide all instrument transformers.

E.4 Approval

Seattle City Light Electric Service Engineering (ESE) shall be the customer's point of contact for all communication and submittals.

Because site-specific metering compartment requirements may vary, customer shall submit manufacturer's design drawings to Seattle City Light Electric Service Engineering (ESE) for review and approval.

Seattle City Light Electric Service Engineering (ESE) shall coordinate the review of the manufacturer's design drawings with Seattle City Light's Meter Section.

Customer shall obtain Seattle City Light approval before releasing metering compartment design to the switchgear manufacturer for construction.

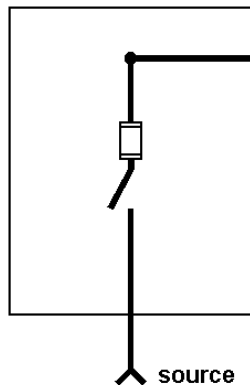
MATERIAL STANDARD**27 kV Metal-Enclosed Interrupter (MEI) Switchgear****APPENDIX F – RECOMMENDED PROTECTION AND CONTROL SCHEMES****F.1 Scope**

The information presented in this appendix was created to facilitate the development of site-specific, 27 kV metal-enclosed interrupter (MEI) switchgear protection and control requirements.

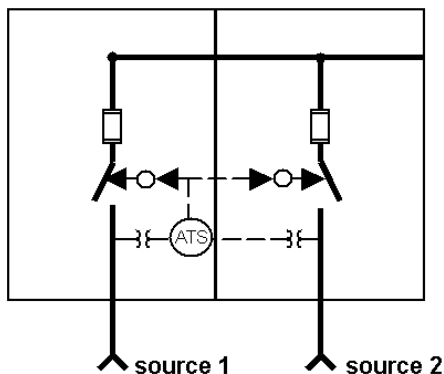
The Purchaser or assigned design engineer is encouraged to contact the System Protection Protection Group for counsel and advice at the earliest stage of the project.

F.2 Recommended Schemes

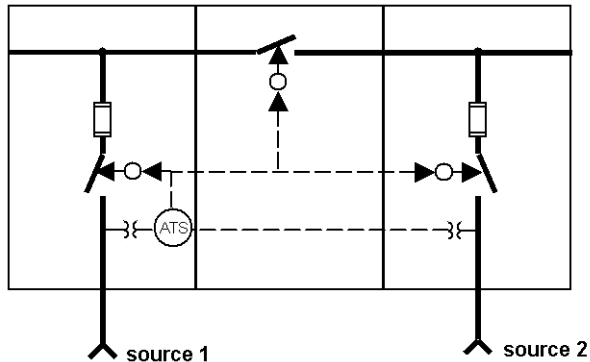
Below are the recommended schemes for five common engineering situations that may be found at Seattle City Light:

F.2.1 Incoming Cubical - Radial Feed System

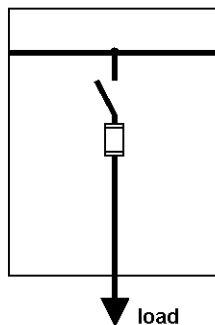
Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device.

F.2.2 Incoming Cubical - Dual Feed System without Tie Switch

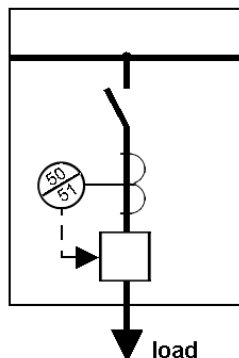
Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Automatic Transfer Switch. Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device. Automatic Transfer option shown. Manual Switching at the discretion of SCL distribution design engineer.

F.2.3 Incoming Cubical - Dual Feed System with Tie Switch

Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Automatic Transfer Switch. Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device. Automatic Transfer option shown. Manual Switching at the discretion of SCL distribution design engineer.

F.2.4 Feeder Cubical - Small Transformer (less than 3 MVA)

Comments - Overcurrent Protection: Max Size 65X - Cooper, (full range current limiting fuse). Fuse must coordinate with upstream protection device.

F.2.5 Feeder Cubical - Large Transformer (3 MVA and greater)

Comments - Overcurrent Protection: Relay, with Phase and Ground Elements; must coordinate with upstream protective devices. Circuit Breaker. The switchgear required for this scheme is outside the scope of this material standard.

F.3 Approval

All protection and control schemes for 27 kV metal-enclosed interrupter (MEI) switchgear assemblies shall be reviewed and approved by the System Protection Group.