// INSTALLATION & OPERATING MANUAL

Medium-Voltage Switchgear

Receiving, handling, installation, bus and cable connections, commissioning, energization, operation, and maintenance for metal-clad and metal-enclosed medium-voltage switchgear supplied by Bet Power.

DOCUMENT	APPLIES TO
BP-IOM-MVSG-001	5 – 38 kV class · 1200 – 4000 A · up to 63 kA

Built for Speed. Priced for Reality.

// READ BEFORE INSTALLING

This equipment carries lethal medium voltages and stores fault energy beyond the range of any PPE. Installation, commissioning, and maintenance must be performed only by qualified personnel trained in medium-voltage switchgear, following the NEC (NFPA 70), NESC (IEEE C2), NFPA 70E, OSHA 29 CFR 1910.269, the serving utility's requirements, and the site arc-flash study. Keep this manual with the switchgear for the life of the equipment.

// CONTENTS

What's in this manual

// HOW TO USE THIS MANUAL

Sections 03 through 10 are sequential. Complete each section's checklist before moving on. Section 11 onward is for the life of the equipment.

The nameplate, approved shop drawings, one-line, three-line, relay settings sheet, interlock drawing, and breaker OEM manual govern over any general value in this manual. If they disagree, stop and call Bet Power Engineering.

> // NAMEPLATE FIRST
> Record the lineup serial number, voltage class, BIL, main bus ampacity, short-circuit rating, control voltage, and every breaker serial number and cell into Appendix A before the sections leave the receiving area.

// DIRECT LINES

Engineering	engineering@bet-power.com
Field support	support@bet-power.com
Logistics (24/7 desk)	logistics@bet-power.com
Orders	orders@bet-power.com

// 01 Safety

Medium-voltage switchgear is the highest-energy equipment most sites own. The incident energy in a breaker cell or cable compartment is routinely beyond the range of any PPE. Nothing here replaces your site's lockout/tagout procedure, the utility's switching orders, the arc-flash study, or NFPA 70E.

> // DANGER — HAZARDOUS VOLTAGE
> De-energize the bus from every source, lock out every source, test for absence of voltage with a rated MV tester at the bus and cable terminations, and apply grounds before opening any compartment. Metal-clad shutters cover the stabs, not the bus behind them; the bus can be live with the breaker withdrawn.

Signal words used in this manual

WORD	MEANING
DANGER	Will cause death or serious injury if not avoided.
WARNING	Can cause death, serious injury, or major equipment damage.
CAUTION	Can cause minor injury or equipment damage.
NOTE	Information that affects performance, warranty, or the next step.

Rules that apply to every section

1. Only qualified persons (NFPA 70E definition) trained in medium-voltage switchgear rack breakers, open compartments, or make connections.
2. Wear arc-rated PPE matched to the incident energy on the arc-flash label. Where the label reads "dangerous" or above 40 cal/cm^2, the compartment is not opened energized under any circumstances.
3. Rack breakers only with the door closed, using the remote racking device where fitted, or the racking crank through the door port. Stand to the side, never in front of the breaker.
4. Never defeat a shutter, cell interlock, key interlock, or ground-and-test device interlock. They exist because someone was killed without them.
5. Keep all doors closed and bolted whenever personnel are not actively working inside.
6. Confirm the ground bus is bonded to the station ground grid before any cable is landed.
7. Voltage transformer (VT) and control power transformer (CPT) drawers: withdraw fully to the disconnected position and confirm the primary fuses are isolated before touching secondary wiring. A VT can back-feed the primary from the secondary.
8. Never open a current transformer secondary under load. It will produce a lethal voltage and destroy the CT.

> // WARNING — MULTIPLE SOURCES
> Main-tie-main lineups, generator sections, and utility feeds from two directions can energize the bus from any side. Isolate and verify every source at the bus, not at one breaker.

// 02 Scope and product description

This manual covers Bet Power metal-clad switchgear (IEEE C37.20.2) with drawout vacuum circuit breakers (IEEE C37.04 / C37.09), and metal-enclosed interrupter switchgear (IEEE C37.20.3) with load-interrupter switches and fuses, 5 – 38 kV, indoor and outdoor.

Typical ratings

PARAMETER	STANDARD RANGE
Rated voltage class	4.76, 8.25, 15, 27, 38 kV (IEEE C37.20.2 / C37.20.3)
System voltage	2400 – 34500 V, 3-phase, 60 Hz
BIL	60 / 95 / 125 / 150 kV per voltage class
Main bus continuous current	1200, 2000, 3000, 4000 A; copper, silver or tin plated, insulated
Short-circuit rating	25, 31.5, 40, 50, 63 kA symmetrical; bus bracing and momentary (2.6 × kA peak) to match
Circuit breakers	Vacuum, drawout, 1200 / 2000 / 3000 A, stored-energy mechanism, electrically operated (48 / 125 VDC or 120 VAC control) with manual charge and close/trip
Interrupter switches (metal-enclosed)	600 / 1200 A load-break, fault-make; current-limiting or expulsion power fuses
Control power	125 VDC station battery (preferred) or 120 VAC from a CPT with capacitor trip
Protection	Microprocessor relays (50/51, 50N/51N, 27/59, 81, 87T, 87B, 32, 67) per the relay schedule; utility-grade metering
Enclosure	Indoor NEMA 1 standard; outdoor non-walk-in or walk-in aisle (NEMA 3R) with heaters, lights, receptacles; ANSI 61 gray
Arc resistance	Type 2B per IEEE C37.20.7 optional, with plenum and pressure-relief flaps
Options	Remote racking, ground-and-test device, surge arresters, VT and CPT drawers, IR windows, partial-discharge sensors, transformer throat

> // NOTE
> The values above are the standard range. The nameplate, approved shop drawings, one-line, three-line, relay settings sheet, and breaker schedule define the exact ratings and lineup for the serial number in hand.

Standard construction (metal-clad)

Structure

- Freestanding 11-gauge steel sections, each with a breaker compartment, bus compartment, cable compartment, and low-voltage control compartment, separated by grounded steel barriers
- Insulated main bus with bolted joints boxed with insulating boots; bus supports in glass-polyester or epoxy
- Automatic shutters cover the primary disconnects when the breaker is withdrawn
- Full-length ground bus, copper, with a ground pad in each cable compartment
- Cable compartment with lug pads, cable supports, and surge arrester mounting; bottom or top entry per the drawing

Breaker and controls

- Drawout vacuum breaker on a racking mechanism with CONNECTED, TEST, and DISCONNECTED positions; interlocks prevent racking a closed breaker and closing between positions
- Secondary disconnect (control plug) engages in TEST and CONNECTED
- Low-voltage compartment: protective relays, meters, control switches, indicating lights, test switches, terminal blocks, and the DC or AC control circuit
- Current transformers (bushing or bar type) around the primary disconnects; VTs and CPTs in fused drawout drawers
- Lifting device or portable lift truck for breaker removal

// 03 Receiving and inspection

Switchgear ships as one or more shipping splits on skids, wrapped, with breakers shipped in their cells (small lineups) or crated separately. Inspect every split and every crate before the carrier leaves.

01 Count shipping splits and breaker crates against the packing list and the shipping-split drawing. Match section serial tags and breaker serial numbers to their cells (breakers are matched to cells; do not swap them).

02 Check tilt / impact indicators on each skid and crate. If tripped, note it on the bill of lading and photograph it.

03 Walk all sides. Look for dents, racked frames, bent doors, broken shipping braces, damaged pressure-relief flaps (arc-resistant), and loose hardware in the wrap.

04 Open the front doors on each split and check: bus supports intact, bus boots in place, shutters operate, no cracked insulators, relays and meters present and undamaged, no loose hardware in the bottom.

05 Check breakers in their crates: vacuum interrupters undamaged (no cracked ceramic), primary disconnect fingers straight, mechanism charged/discharged indicator readable, control plug undamaged.

06 Confirm loose-shipped items: splice kits (bus links, boots, hardware, Belleville washers), section bolts, lifting angles, breaker lift truck or lifting device, racking crank and remote racking device, ground-and-test device, test plugs, keys, spare fuses, drawings, relay settings sheet, and the factory test report.

07 Check for water. Wet switchgear cannot be energized until dried and hipot-tested.

08 Record everything in Appendix A. Note any damage on the bill of lading **before signing**. Have the driver sign it.

> **// WARNING**
> A section that was dropped or tipped may have cracked bus supports or shifted bus that passes visual inspection and fails on the first through-fault. Do not energize. Contact logistics@bet-power.com within 24 hours with photos and the bill of lading.

// 04 Storage

Metal-clad switchgear is an indoor product even when it ships in an outdoor enclosure; outdoor enclosures are weather-tight only when assembled, sealed, and with the heaters running. Store indoors, dry, heated.

- Keep sections upright on skids, off the floor. Do not stack. Keep the ends of shipping splits covered where the bus is exposed.
- Energize the factory space heaters (typ. 120 VAC, on the wiring diagram) or run 250 W of heat per section to stay above dew point.
- Breakers stored upright in their crates or in their cells in the DISCONNECTED position, mechanism discharged, in the same heated space.
- Every 30 days: check for moisture, rodents, dust, and that heaters are on. Log it.
- Storage over 6 months: megger the bus and each breaker, and hipot the bus (Section 09), before energizing.

CONDITION	LIMIT
Storage temperature	−20°C to +60°C
Relative humidity	≤ 80%, non-condensing
Outdoor storage	Not permitted, any enclosure type

// 05 Handling and moving

Section weights are on the shop drawings. A 15 kV, 2000 A section with a breaker installed can exceed 4000 lb; a walk-in outdoor split can exceed 15000 lb. Size rigging for the heaviest split plus 25%.

Lifting

- Lift by the factory lifting angles or eyes only, using all lift points, with a spreader bar so slings are vertical. Included sling angle 60° or steeper.
- Never lift by the doors, bus, breaker, or a single lift point. Remove breakers before lifting sections unless the drawing says they are shipped in place and braced.
- Keep sections upright. Maximum tilt: 10°. Tall sections are top-heavy.
- Remove lifting angles after setting (unless permanent) and plug the holes.

Rollers, skates, forklifts, and breakers

- Roll only on the base channels. Forks fully under the base from the front or rear per the drawing, load centered. Never pick from the side unless the drawing shows side fork pockets.
- Breakers: move only on the factory lift truck or dolly, latched to the breaker. A 15 kV breaker weighs 300 – 800 lb and is top-heavy; never tilt it or leave it on a ramp.
- Lift only high enough to clear the floor. Do not drag sections; use skates.

> // CAUTION
> Twisting the frame by dragging misaligns the breaker cell rails and primary disconnects. A breaker that will not rack after installation is usually a section that was dragged.

// 06 Site preparation and foundation

The approved shop drawings show the lineup footprint, the conduit entry windows, the anchor pattern, and the arc-resistant plenum path if applicable. Build to that drawing. The values below are minimums where the drawing is silent.

ITEM	REQUIREMENT
Floor / pad	Reinforced concrete rated for the lineup weight; level within 1/16 in per section and 1/8 in over the lineup. Embedded sill channels, set level in the pour, are strongly recommended on lineups over 4 sections; breaker racking depends on a flat floor. 4 in housekeeping pad indoors; outdoor pad 4 in above grade with drainage away.
Conduit windows	Match the shop drawing per section. MV cable conduits stub up inside the cable compartment window 2 – 4 in above the floor, deburred and bushed; control conduits inside the low-voltage compartment window. Never under the breaker cell or bus compartment.
Front aisle (110.34)	**Breaker withdrawal aisle: section depth plus 3 ft minimum, or per drawing (typ. 6 – 8 ft) so a breaker on its lift truck can be withdrawn and turned; 4 – 5 ft minimum at 15 kV, 5 – 6 ft at 27 – 38 kV**
Rear aisle	**3 ft minimum where rear access is needed for cable terminations; per 110.34 for the voltage class; none if front-accessible per drawing**

Headroom	**Section height plus lifting-device clearance (typ. 18 – 24 in) or per drawing; arc-resistant gear needs the plenum route and exhaust clearance on the drawing**
Arc-resistant exhaust	Plenum ducted to outdoors or to a space rated for the arc exhaust per the drawing; no personnel or combustibles in the exhaust zone; pressure-relief flaps unobstructed.
Room	Accessible only to qualified persons (110.31); locked; ventilation to reject losses; no piping or ducts in the dedicated space above; lighting on a circuit not fed from the switchgear.
Ambient	**–30°C to +40°C, 24-h average ≤ 35°C; ≤ 3300 ft without derate; outdoor enclosures need heaters and thermostats energized year round**
Grounding	Station ground grid per IEEE 80 with a ground conductor stubbed up at each end of the lineup and at every cable compartment (typ. #4/0 copper); connect to the transformer and building grounds.
Control power	125 VDC station battery with charger, sized per the relay and breaker duty on the drawing; or CPT with capacitor trip. Battery room per NEC 480 and IEEE 484.
Egress	Egress at each end of the aisle (110.33(A)(1)); panic hardware on doors within 25 ft; no dead-end aisle over the working distance.

// 07 Installation and section assembly

Set sections in the order on the shipping-split drawing, starting from the section fixed by the incoming source, the transformer throat, or the utility metering.

01 Pull MV cables and control cables through the conduits and protect the ends before setting sections. Leave enough tail to reach the lug pads with the termination length and the minimum bending radius (Section 08).

02 Remove shipping braces, skids, and hardware tagged "remove before installation." Keep the shipping-split bus link covers on until the sections are aligned.

03 Set the first section over its conduit window on the sill channels or shims under the base channels only. Level in both axes. Rack a breaker into TEST and CONNECTED to confirm the cell is square before setting the next section.

04 Set each subsequent section against the last, top, front, and base flush; bolt the frames together with the supplied hardware. Move the section until the holes line up; never draw sections together with the bolts.

05 At each shipping split: remove the splice covers and boots, install the main bus links with the splice kit (link, bolts, flat washers, Belleville washers), bolt heads oriented per the drawing, torque per Section 08, stripe each bolt, then install the insulating boots over the joint and tape or snap them per the kit. Every joint boot on before the cover goes back.

06 Install the ground bus links at each split.

07 Reinstall the splice covers and every barrier removed. Check that shutters operate in every cell.

08 Anchor each section to the floor through the base channel anchor holes with the size on the drawing (typ. 1/2 – 5/8 in). Required everywhere for MV switchgear. Do not weld the frame to the sills.

09 Bond the ground bus to the station ground grid at both ends of the lineup. Do this **before any cable is landed**.

10 Transformer throat (if close-coupled): bolt the throat flanges, install the transition bus and flexible connectors per the coordinated drawing, torque, and boot.

11 Outdoor enclosures: assemble roof sections, aisle end panels, and doors per the drawing; seal every roof and wall joint with the supplied sealant; energize heaters, lights, and receptacles; confirm door gaskets seal.

12 Arc-resistant: assemble the plenum and pressure-relief ducting per the drawing; confirm every flap moves freely and is not obstructed.

13 Install the breakers: uncrate, inspect, lift onto the cell rails with the lift truck, rack to DISCONNECTED, then TEST. Verify the control plug engages and the breaker charges, closes, and trips electrically in TEST. Leave every breaker in TEST or DISCONNECTED, open, until energization.

14 Seal all conduit windows after cables are landed and inspected with a fire-stop or rodent-block compound.

> **// WARNING**
> A missing Belleville washer, an under-torqued splice, or an incomplete bus boot at a shipping split is the most common cause of a bus fault in new MV switchgear. Every splice torqued, striped, and booted, no exceptions, and photographed for Appendix A before the cover goes on.

// 08 Electrical connections

Medium-voltage cables

- Terminate shielded MV cable with stress-cone terminations (cold-shrink, heat-shrink, or pre-molded) rated for the cable and voltage class, per the termination manufacturer's kit. Semicon cutback and strip lengths are not interchangeable between brands.
- Bolt the termination lug to the cable compartment lug pad with plated hardware, flat washer and Belleville, torqued per the table. Two-hole lugs on 1200 A and above.

- Ground the cable shield (and concentric neutral if present) at the switchgear end to the cable compartment ground bus. Follow the site's shield grounding scheme (single- or multi-point) for the other end.
- Phase sequence follows the bus labels A-B-C (front to back, left to right, or top to bottom as marked, NEC 408.3(E)). Match the utility's phasing on the incoming.
- Train cable with the minimum bending radius (typically 12 × OD for shielded MV cable) and support it on the compartment brackets so the termination carries no weight. Maintain the phase-to-phase and phase-to-ground clearances on the drawing.
- Install surge arresters (where supplied) on the cable compartment mounting with the shortest possible leads to the ground bus. Arresters on every incoming line and on every feeder to a rotating machine or a dry type transformer.

Bus joints and transformer throat

BOLT SIZE	PLATED STEEL, GRADE 5	SILICON BRONZE	WHERE USED
3/8 in	20 ft·lb (27 N·m)	18 ft·lb	Control, small lug pads, arrester leads
1/2 in	50 ft·lb (68 N·m)	40 ft·lb	Cable lug pads, bus splices ≤ 2000 A
5/8 in	85 ft·lb (115 N·m)	55 ft·lb	Bus splices 3000 – 4000 A, throat bus
Ground bus	Per bolt size above	—	Two-hole lugs, no Belleville required on ground

Use a calibrated torque wrench, not an impact. After torque, every MV joint gets its insulating boot or tape per the drawing; an exposed bus joint is a partial-discharge site.

Control, relaying, and metering

- Land the DC (or AC) control power feed on the control power terminal block per the three-line. Fuse per the drawing. Confirm polarity before energizing control power.
- Land the customer control, SCADA, remote trip, breaker status, and alarm circuits on the terminal blocks per the three-line. Every wire labeled to match the drawing.
- CT secondaries: factory-wired to shorting terminal blocks and the relays. Do not lift a CT shorting screw with the primary energized. Confirm every CT circuit is complete (relay, meter, shorting block) before energizing.
- VT and CPT drawers: verify fuse ratings per the drawing; drawers racked in only after the bus is verified.
- Relay settings: every protective relay ships with factory-loaded settings from the settings sheet supplied with the gear, or at factory defaults if no settings were supplied. Verify every relay's settings against the coordination study before energization, and record the settings file version in Appendix A.
- Route control wiring in the low-voltage compartment wireway; control conduits enter only through the low-voltage compartment window.

> // NOTE — KEY INTERLOCKS
> Kirk-key and trapped-key schemes (transformer secondary before primary, main-tie-main, generator paralleling lockout) are set up at the factory per the interlock drawing. Verify every sequence by walking it through before energization, and never file, force, or duplicate a key.

// 09 Pre-energization checks

Every item below is a hold point. Do not energize with an open item. Record results in Appendix A. Commissioning of MV switchgear is normally performed by a NETA-accredited testing contractor under Bet Power's or the engineer's witness.

- ☐ Nameplate voltage, BIL, bus rating, and short-circuit rating match the drawings and the calculated available fault current at the bus. Gear rated below available fault current cannot be energized.
- ☐ All shipping braces removed. Every splice torqued, striped, booted, and photographed. All barriers, splice covers, and compartment covers reinstalled. No tools, hardware, or debris in any compartment. Vacuum every compartment; never blow with compressed air.
- ☐ Ground bus bonded to the station grid at both ends; ground resistance measured and recorded (1 Ω target for a station grid, or per utility).
- ☐ Phase sequence A-B-C verified at every incoming termination against the bus labels.
- ☐ Insulation resistance on the bus, breakers withdrawn, VTs and CPTs withdrawn, cables disconnected or included per the test plan: 5 kV DC phase-to-phase and phase-to-ground, ≥ 5000 MΩ at 20°C (bus alone).
- ☐ AC or DC hipot on the bus per IEEE C37.20.2 field test values (75% of factory test: 14 kV AC for 4.76 kV class, 27 kV AC for 15 kV class, 45 kV AC for 27 kV class, 60 kV AC for 38 kV class, 1 minute, breakers withdrawn). Cables tested separately per IEEE 400 (VLF) before connection.
- ☐ Contact resistance (ductor) across every bus splice and every breaker primary disconnect in CONNECTED: ≤ 50 μΩ per splice; breaker pole per OEM (typ. ≤ 100 μΩ); no joint more than 25% above the average.
- ☐ Each breaker: mechanism inspected, vacuum interrupter integrity test (AC hipot across open contacts per OEM), contact resistance, timing (open/close within OEM spec), electrical close and trip from the control switch and from the relay in TEST position, charge motor current, and anti-pump function verified.
- ☐ Every protective relay: settings verified against the study and the settings file recorded; secondary injection test of every enabled element; trip path proven from relay contact to breaker trip coil; CT ratio and polarity verified (primary injection or ratio test); VT ratio and phasing verified.
- ☐ Every interlock walked through: shutters, racking interlocks, key interlocks, ground-and-test device, and main-tie-main transfer scheme.

- [ ] Control power: battery charger float voltage correct, battery load test passed, DC ground detection clear; or CPT and capacitor trip verified.
- [ ] Surge arresters installed, correct MCOV for the system grounding, ground leads torqued.
- [ ] Outdoor: heaters, thermostats, lights, and receptacles working; roof and wall joints sealed; door gaskets seal. Arc-resistant: plenum complete, flaps free.
- [ ] Downstream: every feeder breaker open and in TEST; transformer secondary mains open; no backfeed sources connected.
- [ ] Arc-flash labels and MV warning signs installed. Aisle clear. Site clear of unnecessary personnel. Fire extinguisher (Class C) within reach.

// 10 Energization

01 Close and bolt every door. All breakers open and in TEST. Nobody in the aisle in front of the gear; the person operating stands at the remote control or the upstream device.

02 Rack the incoming (main) breaker to CONNECTED with the door closed, using remote racking where fitted. Confirm it is open.

03 Energize the incoming from the utility or upstream device per the switching order, with the main breaker **open**. Rack in the incoming VT drawer and verify voltage and phase rotation on the line side at the relay or meter. Do not open a door to measure.

04 Close the main breaker from the control switch or remotely. Listen for 60 seconds. Bus hum is normal; buzzing, crackling, or hissing means trip the main immediately.

05 Rack in the bus VT drawer. Verify bus voltage phase-to-phase at the relays and meters, within ±5% of nominal and balanced within 2%. Verify phase rotation on the bus.

06 Run at no load for 30 minutes. Recheck for noise, smell (ozone smell means partial discharge: trip and investigate), and meter readings.

07 Rack each feeder breaker to CONNECTED with the door closed, one at a time. Close each feeder from the control switch or remotely, largest first, checking each downstream load before the next. Transformer feeders: confirm the transformer's own pre-energization checklist is complete before closing.

08 After 4 hours at operating load: IR scan every cable termination and bus splice through IR windows. No joint more than 15°C above adjacent phases or 30°C above ambient. Partial-discharge survey (ultrasonic or TEV) of every cable compartment: no PD above baseline.

09 Record energization date, voltages, rotation, relay settings version, and IR / PD results in Appendix A. Send a copy of the completed record to support@bet-power.com for the unit file.

> // WARNING — FIRST CLOSE
> The first close of the main is the highest-risk operation in the life of the lineup. A mis-phased incoming, a forgotten shipping brace, or an incomplete bus boot shows up here as a bolted fault at full available current. Complete Section 09 in full, and close the main remotely or from outside the arc-flash boundary.

// 11 Operation

Loading

ITEM	LIMIT
Main bus, continuous	100% of nameplate at 40°C ambient; derate per IEEE C37.20.2 above 40°C
Breakers, continuous	100% of nameplate (vacuum breakers are 100% rated); derate at the OEM's curve above 40°C
Interrupter switches	100% of nameplate; load-break operations per the switch nameplate count
Bus temperature at joints	≤ 65°C rise over 40°C ambient (105°C total) for plated joints per IEEE C37.20.2

Breaker operation

- Open and close breakers from the control switch on the door, from SCADA, or remotely. Local manual close and trip pushbuttons on the breaker face are for maintenance in the TEST position only, unless the site procedure specifically allows door-closed manual operation.
- Rack only with the door closed, breaker open, using the remote racking device where fitted or the crank through the door port. Positions: CONNECTED, TEST, DISCONNECTED. The interlock will not allow racking a closed breaker; if the crank will not turn, the breaker is closed or the interlock is engaged. Never force it.
- After a trip: read the relay targets (which element, phase, current, and time) before reclosing. Reset the relay. Reclose once only if the target indicates an overload or an external fault that has cleared. A differential (87), bus (87B), sudden pressure, or instantaneous overcurrent trip is an internal fault until proven otherwise; do not reclose.
- Vacuum interrupters have a rated number of fault interruptions (on the breaker nameplate). Log every fault interruption against the breaker serial number.
- Main-tie-main: follow the transfer scheme on the drawing. Closed-transition transfer requires the sync-check relay to permit; never parallel two sources without it. Key interlocks prevent the operations the design forbids; do not defeat them.

> // DANGER
> A breaker that trips instantaneously on close is closing into a fault. Do not reclose. Isolate, ground, and find the fault before re-energizing.

Interrupter switches (metal-enclosed)

- Operate load-break switches with the door closed using the external handle, in one continuous stroke. Stand to the side. A stored-energy mechanism completes the operation; do not stop mid-stroke.
- Fuse replacement: open the switch, confirm the viewing window shows blades open, open the door (interlocked), test for absence of voltage, ground, and replace all three fuses with the type and rating on the nameplate. Find the cause of a blown fuse before replacing.

Control power and battery

The station battery is the only thing that trips a breaker on a fault when the AC is gone. Monthly: charger float voltage, DC ground alarm clear, pilot cell voltage and specific gravity (flooded) or impedance (VRLA). Annually: full load test per IEEE 450 / 1188. Replace VRLA batteries at 5 years or on impedance rise; flooded at the manufacturer's life.

// 12 Maintenance

MV switchgear fails at the joints, in the breaker mechanisms, and through contaminated insulation. Maintain per NFPA 70B, IEEE C37.20.2 Annex, and the breaker OEM manual. Keep a log by section and by breaker serial number.

INTERVAL	TASK	UNIT STATE
Monthly	Walk-around: doors closed and bolted, aisle clear, no unusual noise or ozone smell, heaters running (outdoor), relay and meter displays normal, no alarms, battery charger normal, arc-resistant flaps closed and unobstructed.	Energized
Quarterly	Log load current per feeder, bus voltage, relay event records, breaker operation counters, fault interruption count. Check per-phase balance. Battery pilot cell readings.	Energized
Annually	IR scan of all cable terminations and bus splices through IR windows under ≥ 40% load. Partial-discharge survey (ultrasonic / TEV) of every compartment. Exercise every breaker open-close-open (schedule outages by feeder). Verify relay settings unchanged and download event records. Test trip from each relay to each breaker (in TEST). Battery load test.	IR and PD energized; rest per feeder
Every 3 years (or per OEM by operations)	De-energized, grounded: vacuum every compartment; clean bus insulation and supports with dry lint-free cloth (isopropyl alcohol only if contaminated); inspect boots and bus supports for tracking; torque-check 10% of splices (all if any loose); megger bus; ductor splices; inspect and lubricate every breaker mechanism per the OEM manual; breaker contact resistance, timing, vacuum integrity test; clean and lubricate primary disconnect fingers; secondary-injection test every relay; verify CT and VT circuits; exercise shutters and interlocks.	De-energized, locked out, grounded

Every 6 years	Bus hipot at maintenance values (65% of factory). Primary injection of the incoming protection. Replace breaker mechanism lubricant per OEM. Replace VRLA batteries.	De-energized, grounded
After any fault interruption	Inspect the breaker that cleared it (contact resistance, vacuum integrity, mechanism), inspect the cable compartment and bus for damage, megger the feeder, before re-energizing. After a bus fault: internal inspection by Bet Power field service.	De-energized, grounded

Test limits in service

TEST	ACCEPTABLE	INVESTIGATE
Insulation resistance, bus, 5 kV DC, 1 min	**≥ 5000 MΩ at 20°C**	**< 5000 MΩ or a 50% drop from last test**
Contact resistance, bus splice	**≤ 50 µΩ**	**> 25% above adjacent splices**
Breaker pole resistance	**Per OEM; typ. ≤ 100 µΩ**	**> 50% above pole average**
Vacuum integrity (AC hipot across open contacts)	**Withstands OEM test voltage 1 min**	**Any failure: replace the interrupter / breaker**
Breaker timing	**Within OEM spec (typ. close ≤ 60 ms, open ≤ 40 ms)**	**Outside: mechanism service**
IR, any joint	**≤ 15°C over adjacent phase**	**15 – 40°C repair at next outage; > 40°C repair now**
Partial discharge (TEV)	**≤ 20 dB and stable vs. baseline**	**> 20 dB or rising: locate and correct at next outage; > 30 dB now**

Do not

- Blow out compartments with compressed air. Vacuum only, with a non-metallic nozzle.
- Use solvent on bus insulation, boots, or supports except isopropyl alcohol for contamination.
- Swap breakers between cells without verifying the cell code and ratings match. Breakers are matched to cells by rating and interlock code.
- Replace fuses with a different type, speed, or manufacturer's curve without Bet Power Engineering approval.
- Drill or cut the enclosure with the bus installed. Metal chips on insulated bus cause faults.
- Lift a CT shorting screw, or open any CT secondary, with the primary energized.

// 13 Troubleshooting

SYMPTOM	LIKELY CAUSE	ACTION

Main trips on first close	Mis-phased incoming; shipping brace or tool left in; incomplete boot; relay at default settings; CT polarity reversed on differential	Do not reclose. Open, inspect every compartment, megger, verify settings and CT polarity.
Breaker will not rack	Breaker closed; interlock engaged; cell rails misaligned; wrong breaker for the cell	Open the breaker; check interlocks; check cell code; do not force.
Breaker will not close electrically	Mechanism not charged; control power lost; anti-pump latched; close-permissive interlock (sync-check, key) open; control plug not engaged	Check charge indicator, control voltage, relay permissives, plug engagement.
Breaker will not trip electrically	Trip coil open; control power lost; relay output not asserted; wiring	Prove the trip path from relay contact to coil in TEST. A breaker that will not trip is not in service.
Feeder trips on overload (51)	Load exceeds setting; setting below study; CT ratio wrong in the relay	Verify load and CT ratio; correct to the study.
Ground-fault trip (51N / 51G), no fault found	Zero-sequence CT mis-wired or cable shield ground routed through the window wrong; downstream neutral-ground bond on a resistance-grounded system	Verify shield grounds pass back through the zero-sequence CT window; check downstream bonds.
Ozone smell / crackling	Partial discharge: contaminated insulation, incomplete boot, damaged termination, inadequate clearance	PD survey to locate; de-energize; clean, re-boot, or re-terminate.
Hot spot on IR at a termination	Loose lug; undersized lug; termination failing	De-energize, ground, re-terminate, torque, boot.
Hot spot at a breaker disconnect	Finger cluster loose, dirty, or worn; breaker not fully racked	Withdraw breaker; clean and lubricate fingers; check racking travel.
DC ground alarm	Ground on control wiring, breaker coil, or battery	Sectionalize by pulling fuses; find and clear; a second ground trips breakers.
VT fuse blowing	Ferroresonance on an ungrounded system; VT winding failure	Add damping resistor on the open-delta per engineering; test the VT.
Water or condensation inside (outdoor)	Heaters off; roof or wall seal failed; conduit not sealed	De-energize if wet; dry, seal, energize heaters; megger before re-energizing.

// 14 Warranty and support

Bet Power is the manufacturer of record for this switchgear and holds the warranty. The full warranty statement is published at bet-power.com/resources/documentation and governs over this summary.

- Warranty requires installation and commissioning in accordance with this manual, the shop drawings, IEEE C37.20.2 / C37.20.3 field practices, and applicable codes, with a documented commissioning test report and a maintenance log per Section 12.
- Warranty does not cover damage from mis-handling, water ingress, dust or corrosive atmosphere, operation above the short-circuit rating, relay settings not per the study, defeated interlocks, field modification of bus or enclosure, or substitution of breakers, fuses, or relays not on the schedule.
- Breakers, relays, meters, batteries, chargers, and arresters carry their manufacturer's warranty, administered by Bet Power.

Getting help

You talk to the person who built the quote and the engineer who reviewed the drawings. No ticket queue. Have the lineup serial number, the section and breaker serial numbers, the relay event record, and the nameplate photo ready.

Field support and warranty	support@bet-power.com
Engineering (settings, coordination, interlocks, device substitution)	engineering@bet-power.com
Logistics desk, 24/7 (shipping damage, delivery)	logistics@bet-power.com
Web	bet-power.com/contact