

Problem Solved

The mobile trailer serves as an entire secondary assembly for a utility sized substation. The assembly includes the main breaker, feeder breakers, all the usual protection and communication features used by the utility customer, and a battery bay.

Characteristics

Mobile Trailer-mounted Switchgear for use on 5kV/15kV

Switchgear is configured with 1 Main breaker, 3 Feeder breakers, protective relaying, and an onboard 48 VDC battery system.

The mobile trailer-mounted switchgear consists of a walk-up style line-up of draw-out vacuum circuit breakers and associated controls. The switchgear enclosure is durable dry powder painted steel. The longer base, and base parts are two-coat epoxy process painted. The entire assembly is 95kV BIL construction to facilitate use on 5kV and 15kV systems.

The unit includes the following:

- The base of the switchgear unit is bolted to the trailer bed and welded together when possible, to form a complete unit.
- Qty. 3, Portable aluminum platforms are supplied to access bays on the trailer. The platforms are supplied with a method for fastening to the base of the switchgear. Legs are provided for the platforms to support the side that is opposite the trailer. Drop-in guard rails are supplied for each platform. Platform steps, with rails, are provided to place next to the platforms. Rails are removable. Three platforms are provided with the assembly. The platforms will support the weight of a circuit breaker and a man. The platform, rails, and stairs are fitted with threaded grounding studs. The trailer is fitted with NEMA two-hole pattern ground pads linked externally with copper cable. Ground pads are located down each side, and the rear, of the trailer. One platform is intended for use in the control bay (Cubical #5), and two are intended to be used at any location along the trailer.
- The enclosures are Type 3R ANSI 61 Gray. The finish paint and coating system shall meet the requirements of IEEE Std C57.12.28-1999, "Coating system performance requirements". The outside skin is a minimum of 11 gauge.
- A ¼" x 2" copper bus runs the full length of the enclosure, providing access to earth ground of this bus.
- The assembly is furnished with a circuit breaker electrical racking device, a circuit breaker manual operating handle, a breaker cranking handle, a circuit breaker manual charging handle, and a circuit breaker lifting yoke. Storage is provided for all devices.
- All sections of the enclosure are supplied with space heaters to eliminate condensation. A thermostat and humidistat are supplied.
- Outdoor lights are mounted on each end of the unit.
- The bus is all-copper, and grounding stirrups are supplied.
- Rain out flanges or channels are supplied over all openings to prohibit water from running down the enclosure or doors, and into the equipment.
- Rear doors over cable terminations only are hinged and bolted with a padlock provision.
- Hinges on large doors were designed for guaranteed alignment and adequate pressure on gasketed flanges.
- Two removable 10' lightning rods (Pipes) are fixed to the front and rear of the assembly, and are solidly grounded to the base ground.





15kV Mobile Outdoor Utility Substation Secondary, C1304

PRODUCT
DATA
SHEET

Cubicle #1

- 2000 amp main circuit breaker.
Breaker Type: ABB AMVAC.
Breaker rating: 15kV, 25kA Interrupting Current, 2000 amp continuous
- Test Two sets of three (3), 2000:5 multi-ratio current transformers on the transformer side of the breaker rated C200 at the 200:5 Tap, and C100 down to the 1200:5 Tap. One set of three (3), 2000:5 multi-ratio current transformers on the transformer side of the breaker rated C200 at the 200:5 Tap, and C100 at the 1200:5 Tap. One set of three (3), metering class 2000:5, 0.3B1.8.
- One set of three (3) polymer type station class lightning arrestors. Surge arresters are provided at the specified ratings on all bushings except neutral bushings. They are to be supplied properly mounted and braced to withstand shocks and vibration during transit. They are Ohio Brass PVN polymer station class arresters, or approved equal. Surge arresters are supplied with suitable short circuit jumpers for operation at the lower voltage levels.

Nominal Rating	Maximum Rating	Arrester Rating
12.47	13.1	7.65

- Grounding for the surge arresters shall consist of 4/0 copper ground cable with at least 600 volt insulation, routed to the ground bus in the bottom of the switchgear.
- The 2000 amp main is cable fed through an opening in the bottom of the switchgear, which is covered with a solid barrier for transportation. A slotted, split barrier is provided to accommodate up to three (3) 1000 MCM aluminum cables per phase. Cable support is provided internally.
- A circuit breaker test cabinet is mounted in Cubicle #1 and fitted with 30' long leads.
- 2000 amp insulated copper bus.

Cubicle #2

- 1200 amp feeder circuit breaker.
 - Breaker Type: ABB AMVAC.
 - Breaker rating: 15kV, 25kA Interrupting Current, 1200 amp continuous
- One set of three (3), 1200:5 multi-ratio current transformers on the bus side of the breaker rated C400 at the 1200:5 Tap, and C200 down to the 800:5 tap. One set of three (3), 2000:5, multi-ratio current transformers on the line side of the breaker rated C200 down to the 1200:5 tap.
- A draw-out tray with PT fuses is located over the circuit breaker. (See Note 1).
- Fused potential transformers are positioned above the breaker. One set of three (3) wye connected, dual ratio 7200x2400:120 PTs: ABB Type VOZ-11M (See Note 1).
- PT voltage ratio selection is with a primary jumper wire. (See Note 2).
- One set of three (3) polymer type station class lightning arresters. Arresters are the same as specified for Cubical #1.
- The 1200 amp feeder is configured for a cable exit through an opening in the bottom of the switchgear. The opening was covered with a solid barrier for transportation. A slotted, split barrier is provided to accommodate up to two (2) 1000 MCM aluminum cables per phase. Cable support were provided internally.
- 2000 amp insulated copper through bus.

Cubicle # 3

- 1200 amp feeder circuit breaker.
 - Breaker Type: ABB AMVAC.
 - Breaker rating: 15kV, 25kA Interrupting Current, 1200 amp continuous
- One set of three (3), 1200:5 multi-ratio current transformers on the bus side of the breaker rated C400 at the 1200:5 Tap, and C200 down to the 800:5 tap. One set of three (3), 2000:5, multi-ratio current transformers on the line side of the breaker rated C200 down to the 1200:5 tap.
- Draw-out fuses are positioned above the feeder breaker to supply control power transformer. (See Note 1).
- Dry-type control power transformer (CPT), 60KVA min., single phase, dual ratio 7200x2400-240/120V, with five 2.5% high voltage taps. (See Note 1).
- CPT voltage ratio selection is with a primary jumper wire. (See Note 2).
- One set of three (3) polymer type station class lightning arrestors. Arrestors are the same as specified for Cubical #1.
- The 1200 amp feeder is configured for a cable exit through an opening in the bottom of the switchgear. The opening was covered with a solid barrier for transportation. A slotted, split barrier is provided to accommodate up to two (2) 1000 MCM aluminum cables per phase. Cable support were provided internally.
- 2000 amp insulated copper through bus.

Cubicle #4

- 1200 amp feeder circuit breaker.
 - Breaker Type: ABB AMVAC.
 - Breaker rating: 15kV, 25kA Interrupting Current, 1200 amp continuous
- One set of three (3), 1200:5 multi-ratio current transformers on the bus side of the breaker rated C400 at the 1200:5 Tap, and C200 down to the 800:5 tap. One set of three (3), 2000:5, multi-ratio current transformers on the line side of the breaker rated C200 down to the 1200:5 tap.
- One set of three (3) polymer type station class lightning arrestors. Arrestors are the same as specified for Cubical #1.
- The 1200 amp feeder was configured for a cable exit through an opening in the bottom of the switchgear. The opening was covered with a solid barrier for transportation. A slotted, split barrier, was provided to accommodate up to two (2) 1000 MCM aluminum cables per phase. Cable support is provided internally.
- 2000 amp insulated copper through bus.
- The circuit breaker remote operator is stored in the front of this cubicle. (Cubicle#4) (See Note 1).

Cubicle #5

- Control Section- housing relays and electronics
- The Control Section shall include the following:

Quantity	Item
4	SEL-351S
1	SEL-587Z
1	SEL-387E
2	Electroswitch Series 24 LOR
1	GE HAA
1	SEL-2730M
1	SEL-RTAC
1	Vanguard Cal Amp
19	FT-1 Switches
1	Miscellaneous terminators and connectors

- Control power is 48VDC for operating relays and electronics, and sourced from cubical #6.
- A rear door provides access to the back of all relay and control components.
- A hand operated pendant with a 50' cord were supplied for remote circuit breaker close and tripping. The pendant is a water/oil tight NEMA 4 hand held device similar to a crane control pendant. Fitted with a plug, it can be plugged into a receptacle corresponding to any of the circuit breakers in the line-up.
- An A/C and a D/C panel board are included in the rear of this Cubicle. All circuit breaker DC circuits will run directly from the DC panel board.
- Two (2) 120V GFI convenience receptacles.
- One (1) male shore power receptacle is provided for the battery charger. A switch is provided to toggle between shore power and station power.
- Component layout in the cubicle is identical to utility standard layout.
- A switched light is added inside the front and rear of this compartment for easy service.

Cubicle # 6

- Battery and Power Compartment
- The battery compartment is provided with a large double door opening at the end to remove or service batteries as required. The landing is coated with skid resistant paint.
- Four (4) series connected 12VDC, 100Ahr, batteries.
- Batteries are secured with seismic rails similar to unistrut to prevent tipping over, especially during transportation.
- Battery charger/eliminator is provided.
- A retracting mast is fixed to the cubicle for antenna mounting. We will provide mounting provision for customer supplied radio equipment. Details TDB after receipt of order. A mast shall lift the antenna over the top of the enclosure. Provisions are provided to mount on front or rear of enclosure.
- A flush, externally accessible, control termination compartment is located on the side to accept four (4) 4" conduits from below. Holes were covered for transportation. Control wires exiting this structure are terminated on labeled terminal blocks.

1. All wiring external to the switchgear is supported as follows:
 - Entry/exit holes to compartments or boxes are on the bottom. The assembly was shipped with the hole pattern specified by the utility, and holes were covered for transportation.
 - Connections to all devices and accessories (gauges, fans, pumps, sudden pressure relay, etc.) shall accept quick-connect plug-in type connectors whenever possible. If buyer has a preference, a vendor or type was specified. Exception is CT secondary connections, which do not go through plug-in type connectors. CT secondary connections are made with ring terminals.
2. All wiring located in the control compartment is as follows:
 - Wiring neatness is important. Wires was cut to the proper length and be packed in neatly formed bundles that are secured along the compartment routing.
 - Secondary current, potential, power, and all control wiring is stranded copper, 600 volt, Type SIS with cross-linked polyethylene insulation, suitable for a copper temperature of 90 degrees C and conforming to Insulated Power Cable Engineers Association (IPCEA) standards for switchboard wiring.
 - Wiring to devices mounted on hinged doors or panels was extra-flexible stranded.
 - Insulated terminal lugs are used on all current, potential, power, and control wiring. Use flanged fork or ring-tongue terminals, Burndy Type TN, or approved equal.
3. All power, control, and alarm contact wiring that leaves the control cabinet is first terminated on barrier type terminal blocks. Us GE Type EB-25, or approved equal.
4. Current transformer secondary connections:
 - The first termination for all current transformer secondary leads (including all leads from winding temperature and multi-ratio CTs) is on shorting-type terminal blocks located in the control compartment. These terminations are located on the opposite side of the terminal block from any connected device. Use GE type EB-27 or approved equal. The Buyer's tap selection is at these blocks.
 - A separate shorting-type terminal block is required for each separate CT. These blocks are arranged in the sequence of 1, 2, 3 phase, N from top to bottom or from left to right. Each CT secondary is routed from the shorting-type terminal block through its individual test switch located in the control compartment. Switches are wired with the source connected to the bottom. Test switches are designed to provide for calibration of equipment by shorting the CT while inserting a test current signal.
 - CT Secondary Grounding – Ground connections for CTs are made from the hinged side of the shorting test switch by running a wire from the test switch to a ground bus in the control compartment.
5. A ground bus bar is provided in the control compartment for all ground connections required of current, potential, and AC control power circuits. Because this ground bus bar must provide a quality connection to the station ground grid, it is bonded to one of the ground pads at the base of the switchgear. Control compartment walls shall not be used as a ground reference connection. Swing panels and subpanels must be adequately grounded to the control cabinet either by mounting methods or by use of a ground strap. Hinges and latches are not acceptable for establishing a quality ground connection.
6. Separate fuse blocks and circuit breakers are required for each separately protected circuit. Spare fuse block or breaker poles shall not be used.
7. All fuse blocks and circuit breakers are mounted vertically and wired with the source to the top and load to the bottom. These devices shall have positive to the right and negative to the left in DC circuits or A, B, C phase, right to left in AC circuits, looking at the front of the device.
8. All current and potential wires connected to terminal blocks are wired in the sequence 3, 2, 1 phase, N from top to bottom or from right to left.
9. No more than two wires are terminated on the same terminal stud of any terminal block, control switch, relay, etc.
10. All control power transformers shall have the hot leg of the secondary protected by a circuit breaker or fuse and the neutral leg grounded.
11. Seller-Buyer Wiring Interface – Provisions for accepting the Buyer's field connections shall meet the following requirements:
 - All Buyer field connections are made on terminal blocks. All Seller connections to these blocks are on one side of the block leaving the opposite side empty for Buyer connections.
 - All terminal blocks (including CT shorting-type) for accepting Buyer field connections are all located in the same control cabinet. Terminal blocks are grouped in a location that provides optimum wiring access.

Design of Trailer

1. The complete portable substation including all equipment listed in this specification is rigidly and securely mounted on a single semi-trailer equipped with a tandem or tri-axle.
2. The trailer is provided with reflectors, clearance lights, marker lights, stop lights, and turn indicating lights to comply with federal, Kentucky, Virginia, Indiana, and ICC regulations. All lights located within six feet of normal ground level are recessed or provided with metal guards to protect against mechanical damage.
3. The mobile switchgear is designed to meet Kentucky, Virginia, and Indiana restrictions as to maximum width, height, length, and weights as follows, so as to not require special permit for operation on the roadways of these states.
4. The unit is designed with a maximum tongue weight of 25,000 pounds and a tongue height of ~50 inches. Vendor will take responsibility for load distribution on the trailer. Trailer is fitted with king pin compatible with standard truck mounted fifth wheel coupling device.
5. The overall dimensions of the entire portable switchgear trailer unit is 8' 6" in width and 13' 6" in height.
6. The proposal drawing includes the approximate turning radius of trailer in addition to the dimensions stated above. Preference is given to compactness of design in both size and weight parameters.
7. Trailer is drop deck construction. Deck of the trailer is low enough to ensure that the floor of the switchgear is less than 48" from the ground.

Design of Accessories

1. Dual wheels equipped with tires suitable for the load, minimum 12 ply tubeless pneumatic tires. Steel disk-type wheels preferred.
2. Air brakes with emergency breakaway feature on all wheels.
3. 12 VDC lighting circuits.
4. Standard plug-in connections for the trailer light circuits (7 point) and pneumatic system.
5. Air ride suspension with adequate capacity to accomplish G.V.W. requirement.
6. Fifth wheel plate and kingpin both suitable for 90 degree turning.
7. Non-skid platforms and steps for areas where a person would normally need to climb on the portable switchgear to prepare it for transport, operations, or routine maintenance.
8. Four (4) heavy duty hand crank type jacks for leveling the trailer and raising it off the suspension when it is in storage or placed in service.
9. Dual level indicators, one at each jack location.
10. A solid metal base under the switchgear prohibits water and road grime from entering the assembly.
11. Mud flaps are provided to prevent throwing mud to the rear.
12. Wheel chocks with holders for holding the trailer stationary when disconnected from the trailer.

Operating and Safety Features

1. All high voltage parts less than seven (7) feet above ground level are shielded from accidental contact by permanently mounted metal shields.
2. The mobile switchgear is designed so that it can be energized and operated when out-of-level by not more than ten (10) degrees.
3. Mobile switchgear is designed so it can be tilted sideways up to an angle of twenty (20) degrees without overturning.
4. The mobile switchgear will withstand, without damage, a maximum speed in transit of seventy (70) miles per hour on first class paved highways.
5. The mobile transformer is to be supplied with integral storage facilities for all equipment detached during transit and for auxiliary equipment such as special wrenches, ground cables, timbers, and control cables.



Operation side of the switchgear trailer. All circuit breakers and relays face this direction.



Front and rear of the relay control section.



Rear View, revealing termination locations of MV cables, and access to the back of relays and low-voltage panelboards.

