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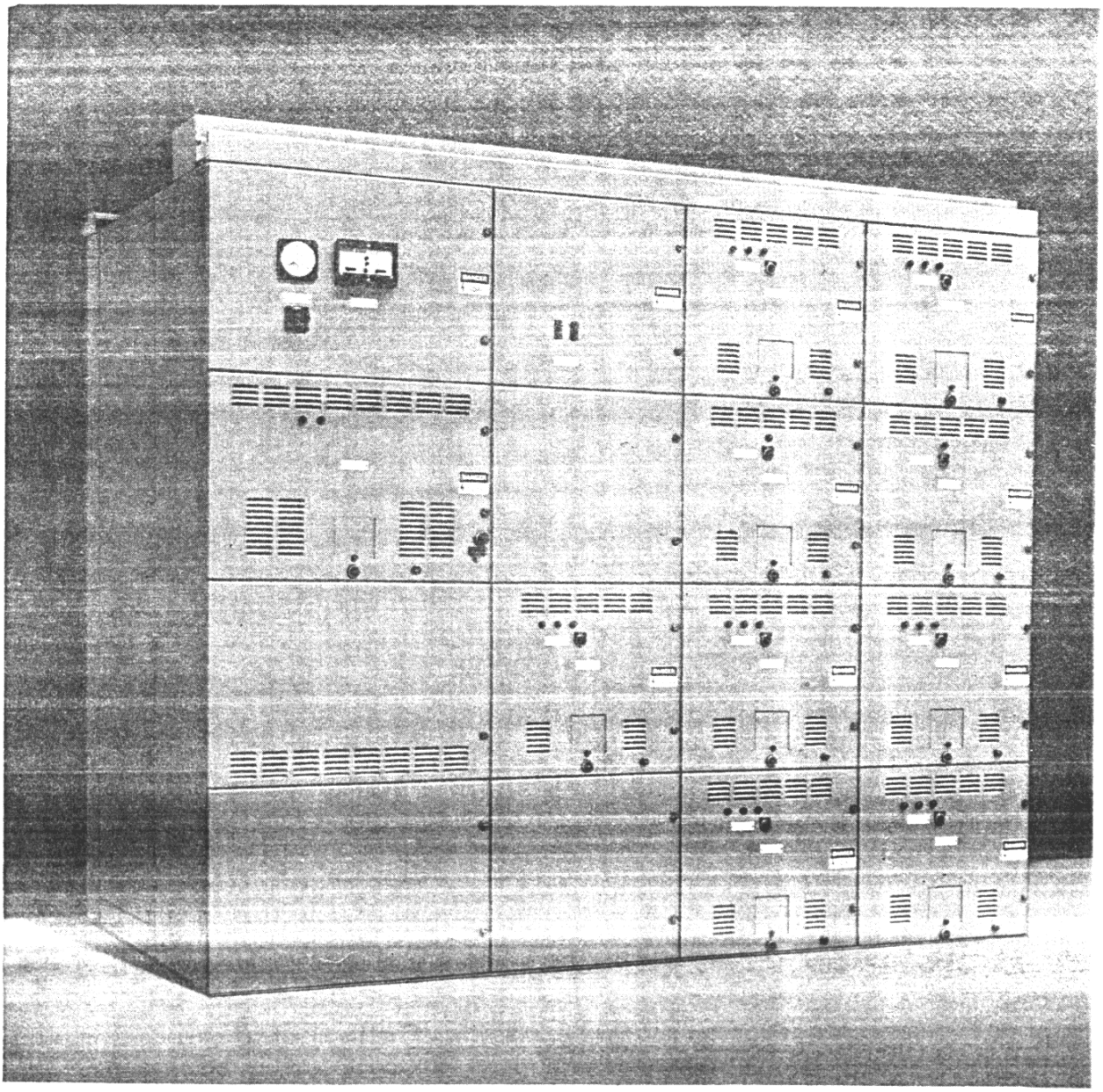
-- BROWN BOVERI

IB 3.1.1.7-1A

Installation/Maintenance Instructions

I-T-E Low-Voltage AC Metal-Enclosed Power Switchgear

Type LK



Brown Boveri Electric

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These instructions do not purport to be cover all details or variations in equipment nor to provide for every possible contingency in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred the nearest District Office.

INTRODUCTION

This manual contains instructions for installation, operation and maintenance of I-T-E Type LK Metal-Enclosed Low Voltage Power Switchgear. The manual, plus the additional documentation furnished, are intended as a guide during initial installation and maintenance. These instructions should be read and thoroughly understood before handling, installing and operating the equipment.

The information in these documents will facilitate proper procedures and maintenance, thus prolonging the life and usefulness of the equipment. File these instructions in a readily accessible place so that reference may be made when needed.

SCOPE

These instructions are general in nature, covering requirements for installation, checkout and maintenance of I-T-E Type LK Metal-Enclosed Low Voltage Power Switchgear. Specific information on particular applications is furnished in the form of contract drawings. These may include, but are not limited to:

a. Bill of Material, listing electrical devices and equipment. The first sheet of the Bill of Material indicates the drawing application.
b. General arrangement drawing of all instrumentation, and weights of shipping sections, with single line diagram showing all power connections, where applicable. Also included is a floor plan showing aisle space and available space requirements for power and control conduits.
c. Elementary and schematic diagrams.
d. Connection diagram.
e. Special construction details, if applicable.

SERVICE CONDITIONS

Unless the switchgear was built to be utilized under unusual conditions in accordance with specifications, it is designed for usual use: in a −30°C (with heaters) to +40°C (without de-rating) ambient; up to 70% relative humidity (without heaters); up to 6600 feet altitude (without de-rating); and in a relatively clean atmosphere (without corrosive fumes, dust or abrasive or conductive dust, salt air, etc).

IMPORTANT NOTES AND WARNINGS

The successful and safe operation of switchgear is dependent upon proper handling, installation, operation and maintenance. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury, and the failure or loss of the switchgear, as well as possible damage to other property. Warning signs are attached to the switchgear to properly warn all users.

WARNING WARNING WARNING WARNING

THERE IS A HAZARD OF ELECTRIC SHOCK OR BURN WHEN WORKING IN OR AROUND ENERGIZED ELECTRICAL EQUIPMENT. TURN POWER OFF AHEAD OF THE SWITCHGEAR (CHECK BOTH MAIN AND TIE CIRCUIT BREAKERS) BEFORE PERFORMING ANY MAINTENANCE OPERATION. ALWAYS CHECK OUTGOING CIRCUIT TO INSURE NO BACK-FEED CONDITION EXISTS. SHOULD ANY OF THE EQUIPMENT NOT FUNCTION AS DESCRIBED IN THE OPERATING PROCEDURE, CONTACT THE NEAREST DISTRICT OFFICE BEFORE ENERGIZING. ONLY QUALIFIED AND AUTHORIZED PERSONNEL WHO HAVE PREVIOUS EXPERIENCE AND TRAINING IN THE OPERATION AND MAINTENANCE OF ELECTRICAL/POWER SYSTEMS SHOULD PERFORM TASKS ASSOCIATED WITH THIS TYPE OF SWITCHGEAR.

GENERAL DESCRIPTION

I-T-E Type LK Low Voltage Power Switchgear is an assembly of metal enclosures containing power circuit breakers, other auxiliary controls and instrumentation/relaying. It is used for protection and control of power circuits on low voltage power distribution systems up to 635 Vac at 50/60 Hz.

The switchgear consists of one or more components, mechanically and electrically connected to create a single, coordinated vertical section of equipment. The equipment may consist of a free-standing section or a multi-section substation. If the equipment is too large for handling as a one-piece assembly, it is split into two or more sections for assembly at the installation site. Figure 1 is an illustration of a typical feeder section.

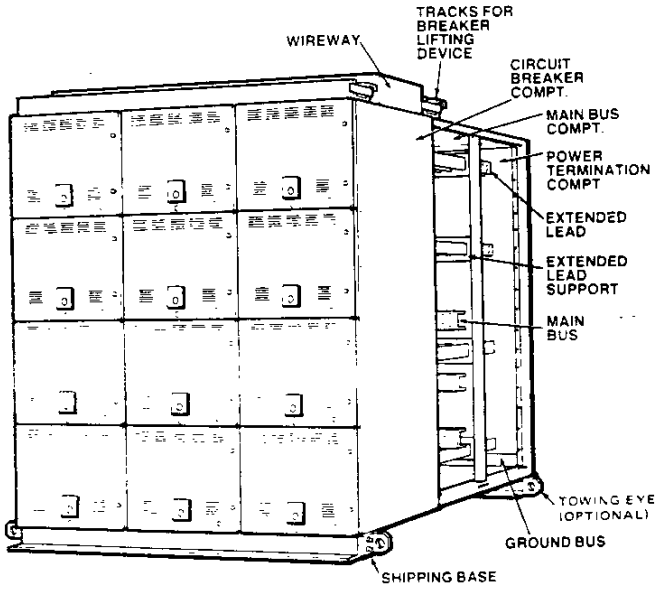


FIGURE 1. TYPICAL FEEDER SECTION

A basic section consists of an enclosure, main bus and terminations. The circuit breakers and instrumentation are located in the front compartment, while the main bus and power terminations (cable or bus duct) are in the rear compartment.

In certain configurations, some compartments are used for instrumentation or auxiliary equipment, rather than circuit breakers, thus permitting a high degree of flexibility in unit design and applications.

TRANSPORTATION

The switchgear is shipped assembled to the maximum extent practical, either as a free-standing section, or, if size or other considerations make it necessary, as divided assemblies. The equipment is braced and blocked as required to prevent damage during transportation. Each shipping section is marked with unit number, shipping weight and identification. Circuit breakers are shipped in separate, individual cartons or crates.

Immediately upon receipt of the switchgear, examine the shipment for evidence of damage sustained during transportation. Check the contents of the shipped material against the packing list before discarding any packing material to insure against inadvertant loss of small parts. If there is any discrepancy, notify the nearest District Office at once.

Brown Boveri Electric is not responsible for any damage that may occur after delivery of the shipment to the carrier. If the damage indicates rough handling, a claim for damage should be filed at once with the carrier and the Company promptly notified.

UNLOADING PROCEDURES

The following are recommended methods for unloading and handling of metal-enclosed switchgear. Some methods are based on availability of an unloading dock, and access to motorized material handling equipment, while other methods require the use of a lifting crane of sufficient capacity to safely handle the equipment.

Towing.

Switchgear with a metal shipping base (optional) and equipped with towing eyes (optional) may be towed.

a. Bring the vehicle to the loading dock. If the vehicle bed and the dock are not level, use a steel ramp with sufficient load capacity to safely handle the switchgear weight.
b. Attach a chain with a rating ample for safe handling of the switchgear to the towing eyes at the end of each shipping base, and secure to the towing equipment. Figure 2 illustrates the proper method of chain attachment.

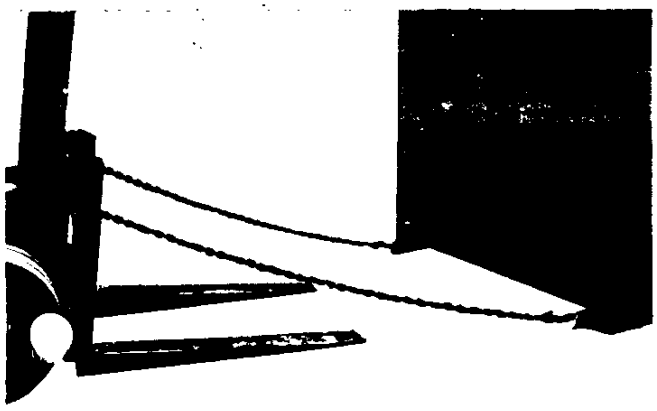


FIGURE 2. ATTACHMENT OF CHAINS FOR TOWING

c. Make sure that the towing force is evenly applied to prevent any lurching or rocking motion being imparted to the switchgear, as stress damage could result. Slowly pull the equipment until the shipping bases are completely located on the dock.

Overhead Lifting.

The switchgear can be lifted from its conveyance by an overhead hoisting device. Slings of ample rating should be attached to holes of roof lifting angles. When switchgear is overhead lifted, it is required that spreaders be used with cables or slings to obtain a vertical pull on the lifting angles. Figure 3 illustrates the use of spreaders and cables or slings for overhead lifting. The tracks of the traveling circuit breaker lifting device, when furnished, serve as lifting angles.

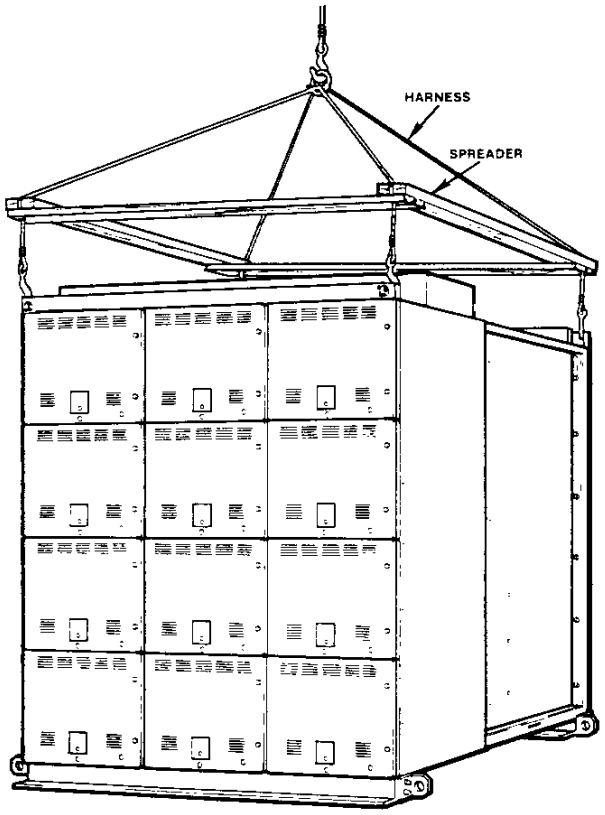


FIGURE 3. OVERHEAD LIFTING ARRANGEMENT FOR INDOOR SWITCHGEAR

2-3.3 Jacking and Rolling.

If no lifting device or motorized material handling equipment is available, the switchgear can be unloaded manually from the conveyance to the dock area. The bed of the conveyance should be even with or slightly higher than the dock for ease of movement. A detailed description of this method is given in the section "INDOOR INSTALLATION". Refer to this portion of the instructions before attempting to unload the switchgear manually.

STORAGE

It is recommended that the storage building be so constructed that it is not subject to flooding and that the floor is paved and well drained. It is also recommended that the ambient storage temperature of the building be warm (approximately 15°C) and dry (50% maximum humidity).

Some indoor switchgear sections are shipped covered with plastic wrap to protect the equipment from dust, dirt and weather during shipment. This plastic wrap must be removed after the equipment is placed in storage at the job site.

Leave each switchgear group on its shipping base until final installation. Remove circuit breakers and accessories from the shipping cartons or crates, following the separate instructions included.

Cover the switchgear with heavy wrapping paper or other moisture barrier material to keep dirt and moisture from entering, as these contaminants may foul working parts and deteriorate contacts and insulation. Louvered or filtered openings should not be covered to restrict ventilation. Plastic film wrapping materials are not recommended as these materials tend to retain moisture due to condensation.

If the switchgear is to be stored for any length of time, or in any place where dampness may be present, heaters (300 W per section) should be used to keep the switchgear dry until it is placed in service. When outdoor switchgear equipped with heaters is stored, the power source for the heaters should be brought to the load terminals of the thermal circuit breakers or cutout device which controls the heater circuits.

CAUTION CAUTION CAUTION CAUTION CAUTION

THE CIRCUIT BREAKER OR CUTOUT DEVICE MUST REMAIN OPEN WHEN A SEPARATE POWER SOURCE IS USED. MAKE SURE THAT ALL CARTONS, PACKING MATERIAL, ETC. ARE REMOVED FROM THE SWITCHGEAR BEFORE ENERGIZING THE HEATERS.

PREPARATION OF FLOOR

Floor plan drawings were supplied for each installation. Recommended aisle space is shown on the drawing; this is an important consideration in determination of switchgear location. This space includes that required at front and rear of the switchgear for opening of doors, removal of circuit breakers, and for the suggested method of securing the unit to the floor. The floor or foundation must be strong enough to support the weight of the switchgear. If the installation is subject to seismic experience, special instructions were given on the general arrangement drawings.

The design of the floor may include iron sills imbedded in the concrete. It is important that these be straight and level their full length, and that correct spacing is maintained throughout. It is recommended that ties be bolted between the sills at various intervals, after which the sills should be shimmed flush with the finished floor. The floor should be smooth to facilitate positioning of the switchgear and the handling of the circuit breakers. The concrete level should not project above the top of the channels.

If conduits are to be used for power and secondary (control) cabling from the floor, they should be installed before the installation of the housings. These conduits should not extend more than one inch above the station floor level and should be plugged before pouring concrete.

A common method of securing the unit to the floor is by welding to these sills. (Welding instructions are shown on the furnished floor plan drawings). If bolting is elected as a method of securing, bolts should be in place before pouring concrete.

INDOOR INSTALLATION

Before starting installation activities, refer to the general drawings. The switchgear should be unloaded as close to the installation site as possible. The most practical method of moving the switchgear to its final location is by the use of jacks and rollers.

Raise the unit by inserting lifting jacks adjacent to the shipping base, as illustrated in Figure 4.

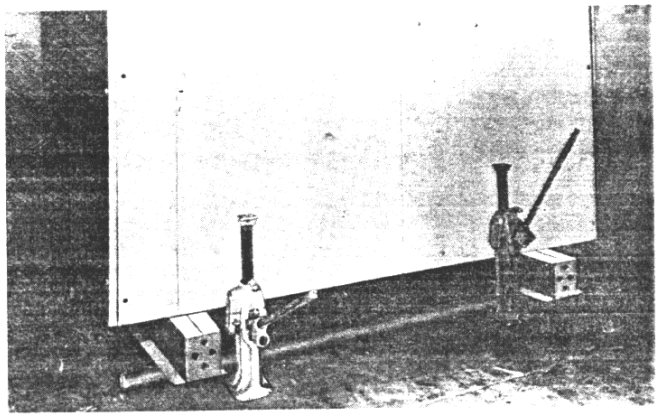


FIGURE 4. USE OF LIFTING JACK

CAUTION CAUTION CAUTION CAUTION CAUTION

DO NOT APPLY JACKS TO THE HOUSING AT ANY OTHER POINTS TO AVOID DISTORTION. USE OF FORK LIFT TRUCKS FOR JACKING MAY RESULT IN DISTORTION AND DAMAGE TO SWITCHGEAR

Jack the unit evenly and place a roller on the floor so the roller is under one end of the shipping base. Lower onto the roller. Take precautions to prevent sliding of the housing. Repeat jacking and roller placement on the opposite end. Raise the unit evenly and place the second roller as illustrated in Figure 5. Place a third roller so the base channel engages the third roller before the rear roller is free. As the switchgear is moved the released roller should be shifted from the rear end to the forward end. Continue this roller engagement method until the unit is at the desired location.

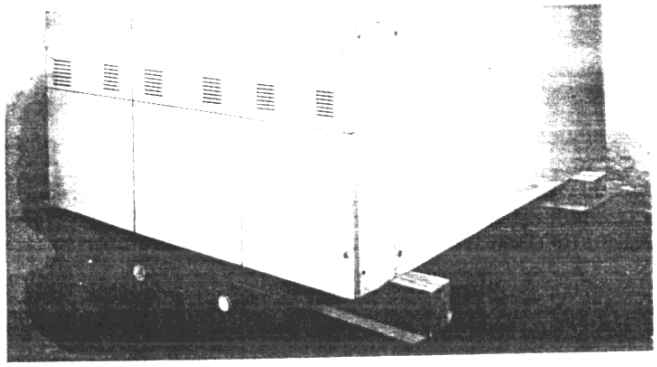


FIGURE 5. PLACEMENT OF ROLLERS

If it is necessary to move the assembly in a lateral direction to position it directly over the installation site, additional channels will be required. Jack the assembly up evenly, place a steel channel under the shipping base and on the repositioned roller, as illustrated in Figure 6 and lower the jacks. Jack the other side so that similar roller and channel placement can be accomplished. Move the assembly until it is directly over the installation site. Figure 7 illustrates jacks removed so that lateral motion can be made. In performing the jacking and rolling operations, make sure that no obstructions will be struck. If floor conduits or other obstructions must be avoided, use additional rollers so that housings are fully supported over the obstructions.

Jack the assembly uniformly and remove the rollers and channels (Figure 8) and lower the assembly to the floor.

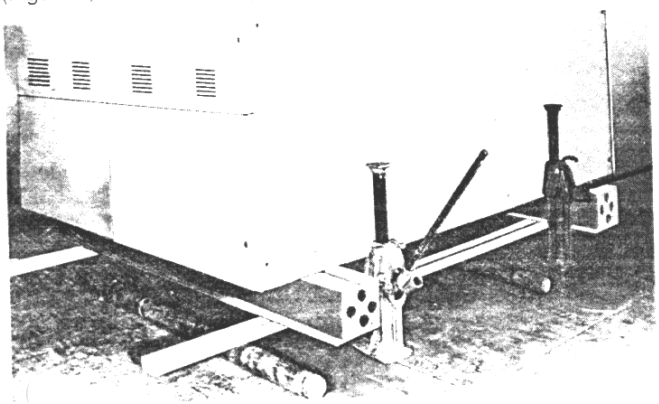


FIGURE 6. SETUP FOR LATERAL MOVEMENT

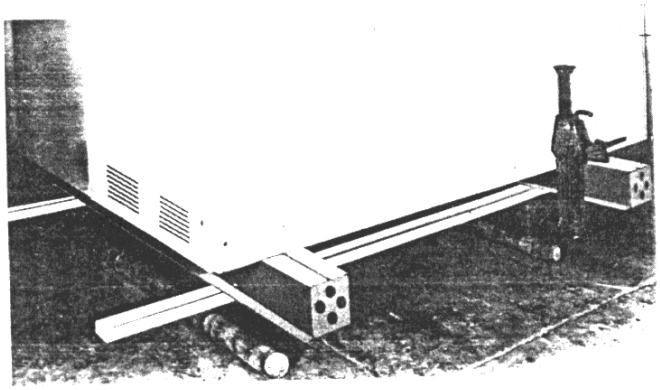


FIGURE 7. REMOVAL OF JACKS

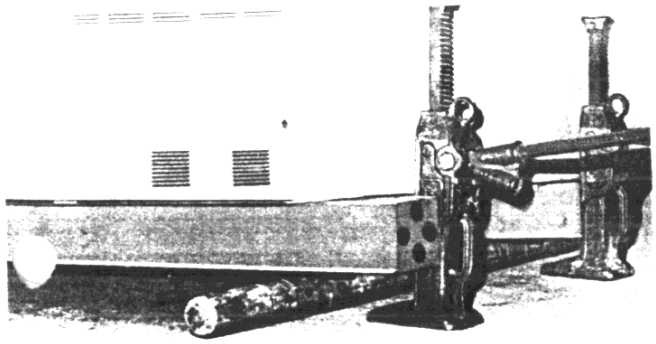


FIGURE 8. REMOVAL OF ROLLERS AND CHANNELS

Removal of Shipping Base.

Open the switchgear doors and remove the bolts fastening the shipping bases to the switchgear, as illustrated in Figure 9. Close all doors and panels before proceeding further.

Jack up the switchgear uniformly to a height at which the bases can be removed. It is necessary that four jacks be used to keep the equipment level and to prevent housing distortion during jacking. Remove the base as illustrated in Figure 10. Select four pieces of timber of sufficient thickness to permit toe of jack to be removed after lowering. Place a piece of timber at each corner, and then slowly lower one side of housing until it rests on the other side, so that the equipment now rests on the four timber pieces. Use a crowbar and timber fulcrum, as illustrated in Figure 12 to raise the assembly sufficiently to permit removal of each timber piece.

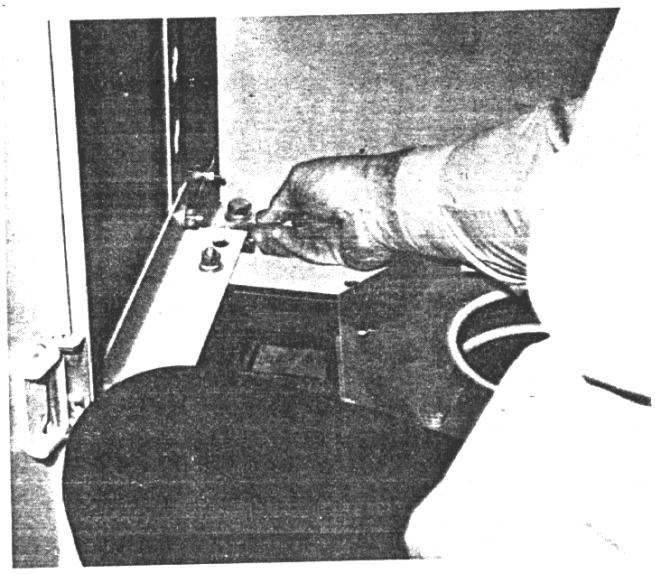


FIGURE 9. REMOVAL OF BOLTS OF SHIPPING BASE

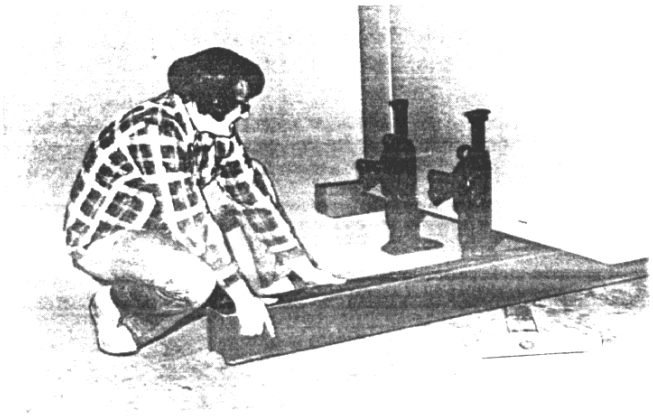


FIGURE 10. REMOVAL OF BASE

CAUTION CAUTION CAUTION CAUTION CAUTION

USE THE CROWBAR AT THE SAME POSITIONS USED FOR JACKING TO AVOID DISTORTIONS OR DAMAGE.

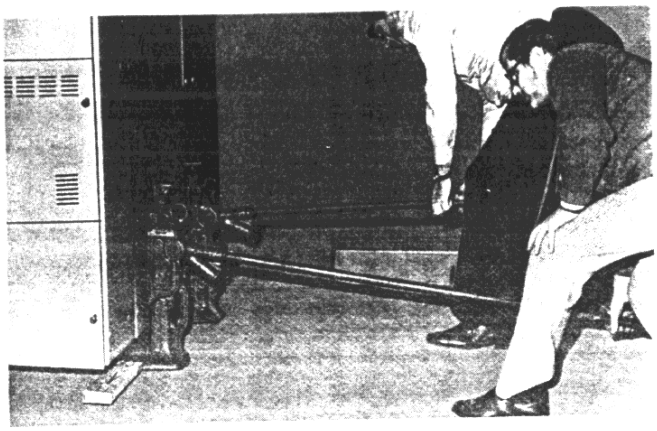


FIGURE 11. PLACEMENT OF TIMBERS

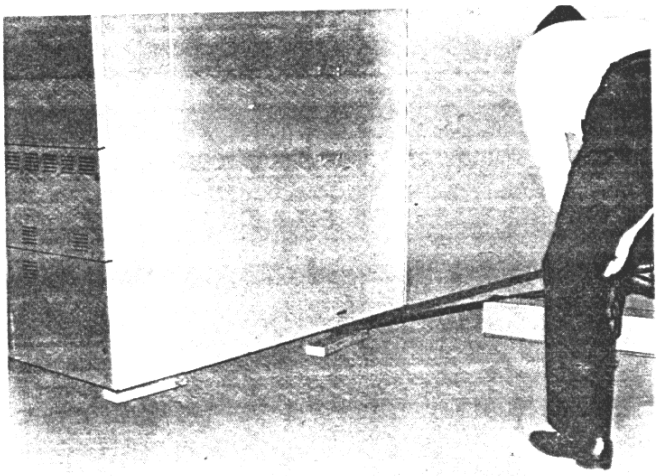


FIGURE 12. USE OF CROWBAR AND FULCRUM

With the assembly raised, remove the corner piece and slowly lower the housing until it touches the floor. Repeat this step to remove timber pieces at other corners. Figure 13 is an illustration of corner piece removal.

Final positioning of the structure is conveniently accomplished by use of a crowbar. Greasing the floor prior to lowering the switchgear will facilitate final positioning.

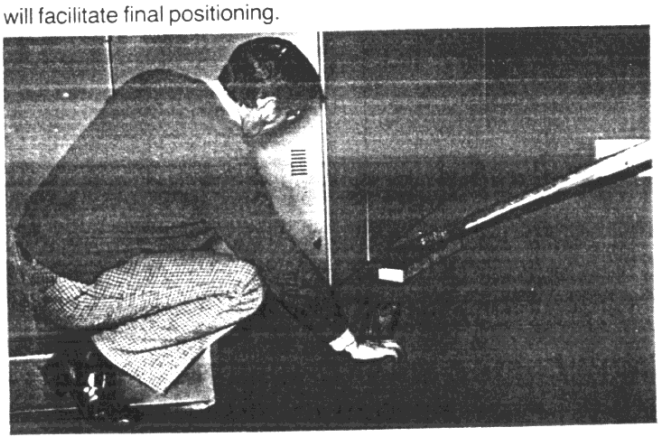


FIGURE 13. REMOVAL OF CORNER PIECES

CAUTION CAUTION CAUTION CAUTION CAUTION

WHEN FIELD ASSEMBLY IS REQUIRED SUCH AS AT SHIPPING SPLITS OR PERIODIC MAINTENANCE REQUIRING DISASSEMBLY, OR PARTS BEING REPLACED: IT IS IMPERATIVE THAT THE HARDWARE CALLED FOR AND FURNISHED BY THE MANUFACTURER BE INSTALLED IN ACCORDANCE WITH APPLICABLE DRAWINGS. IF NO DRAWING IS AVAILABLE, AND THERE IS NO SIMILAR ASSEMBLY NEAR TO USE AS AN EXAMPLE, THE MANUFACTURER SHOULD BE CONSULTED. THERE CAN BE SITUATIONS WHERE HARDWARE CLEARANCES, HARDWARE TORQUE VALUES, AND EVEN THE MATERIALS FROM WHICH THE HARDWARE IS MADE ARE ALL ESSENTIAL TO THE PROPER OPERATION OF THE SWITCHGEAR.

Installation of Sections.

All I-T-E metal-enclosed switchgear is shipped fully assembled to the maximum extent practical. If the length of a complete assembly makes it necessary to split the assembly for shipment, reassembly at installation will be necessary. Secondary and control wiring across shipping splits will be terminated adjacent to the split. The individual wires are tagged to correspond with the terminal block markings. Main and ground bus sections will be separated at the split and the splice plates shipped loose, but with the switchgear.

The center section should be installed first, and then remaining sections added at each end. It is important that each section be checked and any distortion corrected before moving in the next section. A plumb bob is useful in checking for vertical distortion (sway).

Specific field assembly drawings will be furnished where necessary. These drawings will be listed on the front sheet of the Bill of Material.

After all sections have been erected and bolted together, the bus, secondary and control wiring must be reconnected at points where separation took place. All bolted joints should be tightened to proper torque values. See Table 1. When replacing secondary and control wiring check the connection diagram to insure that all connections have been made. Detailed instructions for making electrical connections are given in the section "CONNECTIONS"

OUTDOOR INSTALLATION

Outdoor installation is handled in a similar fashion to indoor installation, except that shipping bases are not removed. Outdoor switchgear is constructed with a permanent steel base that serves as a foundation for the equipment, and also functions as the shipping base. Use of overhead lifting facilities is most common for outdoor installation. Lifting holes are provided at each end of the steel bases for attachment of lifting slings. Slings must be equipped with spreaders placed above the assembly to prevent damage to the top of the switchgear.

CAUTION CAUTION CAUTION CAUTION CAUTION

DO NOT ATTACH SLINGS TO THE HOUSING AT ANY OTHER POINTS.

Floor preparation for outdoor installation is shown on the floor plan drawings of each order.

NNECTIONS

Bus Bars.

Assure that the contact surfaces at bus joints are clean, smooth and flat with no damage or corrosion of plating on the mating surface. The contact surfaces may be cleaned by using a solvent. Use of solvents should be limited to removal of grease and contamination from primary conductors and insulation.

WARNING WARNING WARNING WARNING

FOR PERSONNEL SAFETY, USE ONLY APPROVED SOLVENTS PER OSHA OR LOCAL REGULATIONS. AVOID PROLONGED EXPOSURE TO SOLVENT VAPORS. USE SOLVENTS IN A WELL-VENTILATED AREA.

When bolting conductors together, follow the illustration in Figure 14 for proper hardware placement to insure good electrical contact. Tighten hardware to the torque values given in Table 1.

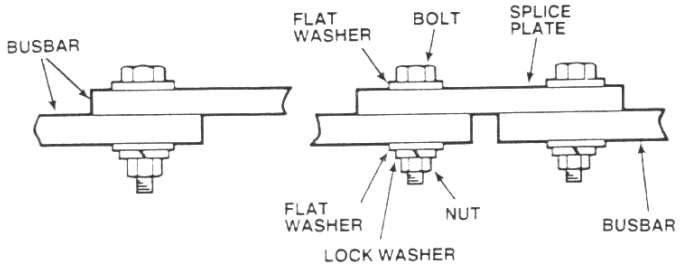


FIGURE 14. BOLTING OF CONDUCTORS

TABLE 1 TORQUE VALUES FOR LOW VOLTAGE EQUIPMENT HARDWARE

BOLT SIZE	FOOT-POUNDS (DRY THREADS)
3/8	15-35
1/2	30-45

Ground Bus.

Ground bus must be continuous through the complete assembly and solidly and permanently connected to the station ground by conductors of at least the same capacity as the housing ground bus. Ground cable or bus should not be run in conduit. The path should be as direct as possible to the station ground. The floor plan furnished with the equipment shows the locations of switchgear ground pads for station ground connections.

WARNING WARNING WARNING WARNING

BEFORE MAKING ANY PRIMARY SOURCE CONNECTIONS, MAKE SURE THAT THE PRIMARY CABLES ARE DEENERGIZED.

Primary Cables.

Identify the primary cables for correct phase sequence connections in accordance with the General Arrangement drawing. It is important that electrical clearance between cable routes and bus bars be maintained. Cable routes should be as straight as possible and be adequately supported to prevent any motion during stress periods. When installing cables inside the switchgear, avoid sharp turns and ...ges to prevent possible damage and weakening of cable ...sulation.

Control Power Source.

Control connections between frames are routed through a wireway located on the top of the enclosures. The control wires may exit either through top or bottom conduits, as required. Terminal blocks are provided for control source connections and interconnections, where necessary. Check for proper polarity if d-c is used, before making connections. When connecting across shipping splits, check tagged wires against terminal block markings to insure proper connections. After completion of connections, check all control wiring with the connection diagram to make certain that all connections have been made, all circuits completed and all connections tightened.

The control source wiring to the switchgear should be of sufficient size to minimize voltage drop, especially if the source is some distance from the switchgear. Standard control device voltage ranges are applicable *at the terminals of the device, with maximum current flowing.*

CIRCUIT BREAKERS (See IB 6.1.1.7-1)

General.

Circuit breakers are shipped separately and should be installed in their permanent locations as soon as practicable.

If the circuit breakers are not to be placed in service for some time, it is required that adequate means of protection be provided. Detailed instructions for protection of the circuit breakers during storage are included in the circuit breaker instruction manual.

Each circuit breaker should be identified by referring to circuit breaker packing lists, and escutcheon, and General Arrangement drawings for proper compartment location. For handling of circuit breakers, and for the procedure of inserting them into the switchgear compartment and removing them, refer to the circuit breaker manual. Before placing the circuit breakers in their respective compartments, check that all packing, blocking, and foreign materials have been removed. Make sure that the tie-down cords retaining the tracks have been removed. All circuit breakers of like frame size rating are interchangeable.

Primary Disconnects.

Each primary terminal of a drawout circuit breaker is equipped with a disconnect consisting of movable contacts as illustrated in Figure 15. The mounting of these contacts on the circuit breaker permits inspection when the breaker is withdrawn. This is a high pressure self-aligning device. The stationary male disconnecting contacts are rigidly mounted in the switchgear.

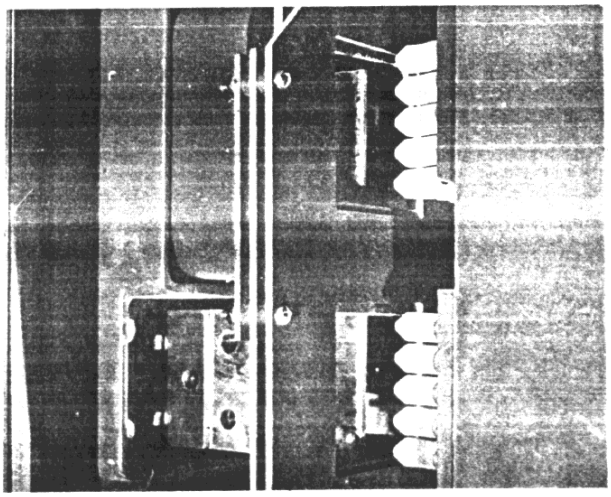


FIGURE 15. PRIMARY DISCONNECTS

Secondary Control Disconnects.

Circuit breakers with electrical features or 4-wire ground are provided with separable disconnects of the self-aligning, high pressure type as shown in Figure 16. The movable contacts (fingers) are on the circuit breaker to facilitate inspection and maintenance. These devices make contact in the CONNECTED and TEST positions, and no test jumper is needed.

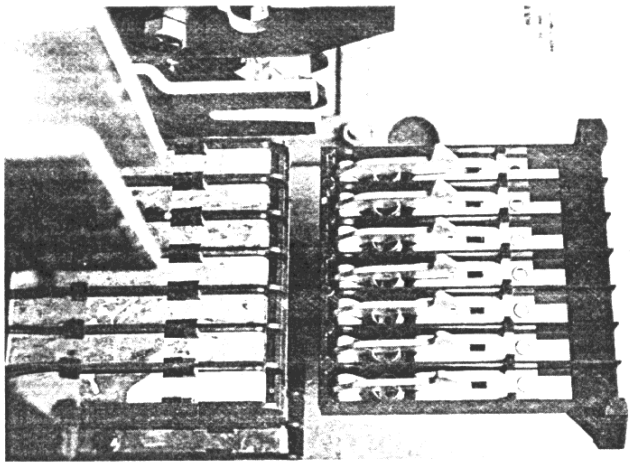


FIGURE 16. SECONDARY DISCONNECTS

Ground Contacts.

Each circuit breaker frame is securely grounded to the housing frame by means of a ground disconnect.

A ground bus is bolted into the bottom frame of the rear compartment extending the whole length of the housing. The ground bus is readily accessible in the termination compartment for cable and conduit grounding provisions. It is important that a reliable ground connection be maintained.

Control Wires.

The control leads and their connectors are usually accessible in the circuit breaker compartment except those of neutral sensors and ground sensors, which necessarily extend into the rear compartment. All electrically operated equipment is connected to these control wires through a suitable control circuit protective device.

Drawout Positions.

Each circuit breaker has four drawout positions in its housing:

Interlocks prevent moving a circuit breaker from one position to another unless the breaker is open, and prevents closing the circuit breaker between positions.

-In the "WITHDRAWN" or "OUT" position, primary, secondary and ground disconnects are disengaged, the closing springs are discharged, the safety shutter is closed and the circuit breaker can safely be removed or connected.

-In the "DISCONNECT" position, the primary disconnects on the circuit breaker are disengaged and separated a safe distance from the stationary part of the contacts located in the compartment. All secondary control and ground contacts are disengaged.

-In the "TEST" position, the primary disconnects are disengaged, but selected secondary control contacts and the ground contacts are connected and the circuit breaker may be operated. "TEST" position should be used for testing circuit breaker operations but it is not suitable for any inspection or maintenance of the breaker. The shutter is open in this position.

-In the "CONNECTED" position, the primary disconnects are engaged, the shutter is open and all secondary control contacts, except those connected to the test push buttons on the circuit breaker, are connected.

BREAKER OVERHEAD LIFTING DEVICE (Optional)

General.

For ease of handling LK circuit breakers, a traveling overhead lift device may be provided. This device is supported from the front section of the switchgear assembly. The hoist can be moved the full length of the switchgear and, with the aid of a lifting yoke, the breaker can be lifted from the floor or from the completely withdrawn breaker cradle. Lifting power is provided through a removable hand-crank, worm-driven mechanism and sturdy flexible cable. Although the driving mechanism is designed for easy hand operation, the weight of the circuit breaker cannot accidently move the mechanism. Detailed operating instructions are given in Drawing 368 486, which is included with the lifting device shipment.

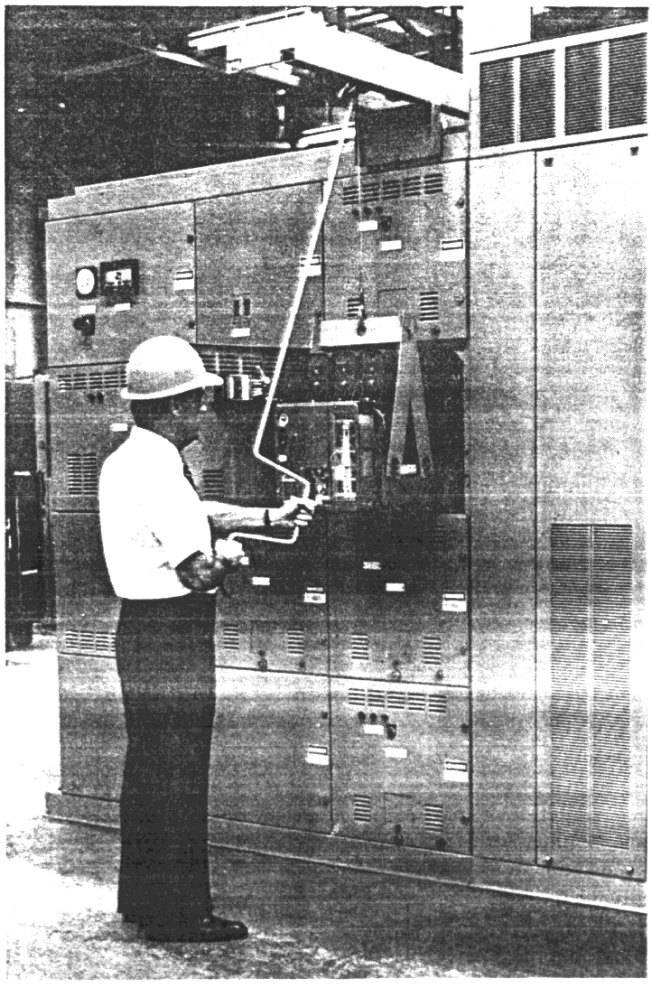


FIGURE 17. OVERHEAD LIFTING DEVICE

TION CAUTION CAUTION CAUTION CAUTION

1. BE SURE THE CIRCUIT BREAKER LIFTING DEVICE WHEELS ARE SEATED PROPERLY ON THE TRACK AND THE CABLE IS SECURELY FASTENED TO THE DRUM. THE CABLE ATTACHMENT TO THE DRUM SHOULD NOT BE DEPENDED UPON TO SUPPORT FULL CAPACITY. ALWAYS ALLOW 4-5 WRAPS OF CABLE TO REMAIN ON THE DRUM WHEN THE LOAD IS PLAYED OUT.
2. DO NOT USE THE CIRCUIT BREAKER LIFTING DEVICE FOR MORE THAN ITS 800 LB. CAPACITY.
3. GUARD AGAINST SNARLING KINKING OR KNOTTING OF THE CABLE.
4. DO NOT LIFT LOADS OTHER THAN CIRCUIT BREAKERS.
5. DO NOT MAKE ANY ALTERATIONS TO THE LIFTING DEVICE.
6. NEVER WALK OR STAND UNDER A CIRCUIT BREAKER SUSPENDED ON THE OVERHEAD LIFTING DEVICE.
7. DO NOT LEAVE A CIRCUIT BREAKER SUSPENDED ON THE OVERHEAD LIFTING DEVICE.

TESTING AND INSPECTION

With the switchgear assembly in place, perform the following:

1. Remove all extraneous material and clean out any dirt or grease. If the equipment has been stored in a damp or wet area and there is a possibility that moisture may have penetrated the interior, the equipment should be dried with air and/or heat. Make sure that all moisture has been removed.
2. Remove all shipping blocks and zero time dial settings in relays that were used for shipping protection.
3. Conduct potential tests to check for any damaged insulation. Consult Table 2 for values.
4. Set all relays, regulators, and other devices for proper operation of loads. No relays are set at the factory.

TABLE 2
ONE-MINUTE WITHSTAND VOLTAGES
(PRIMARY CIRCUITS)*

FACTORY TEST		FIELD TEST	
Rated Voltage (rms)	one-minute Withstand (rms)	one-minute Withstand (rms)	DC Withstand**
Up to 600V	2,200V	1,650V	2,300V

*Only dielectric tests are called for in standards. If megger tests are required use only a 500V device with a one (1) megohm minimal acceptable level. For higher values, record and compare with future readings, noting large deviations as problems.

**The column headed "DC Withstand" is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage class of switchgear. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to ANSI C37.20, either for design tests, production tests or conformance tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

CAUTION CAUTION CAUTION CAUTION CAUTION

EXERCISE EXTREME CARE TO INSURE THAT THE EQUIPMENT IS NOT CONNECTED TO THE PRIMARY POWER SOURCE DURING TESTING.

DO NOT EXCEED THE LISTED VOLTAGES FOR THE VOLTAGE CLASS OF THE EQUIPMENT UNDER TEST.

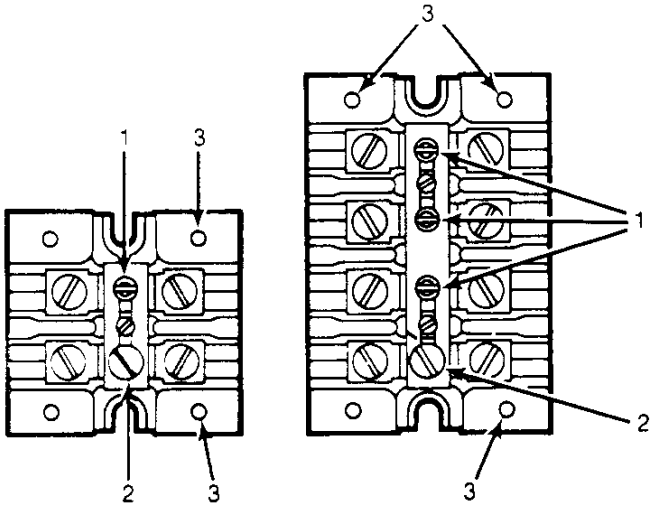
IF PHASE TO PHASE TESTS ARE MADE IN ADDITION TO PHASE TO GROUND TEST, CARE MUST BE TAKEN THAT NO SHUNT CONNECTED COILS SUCH AS POTENTIAL TRANSFORMERS ARE CONNECTED DURING THE TESTS.

DO NOT TEST SOLID-STATE SENSORS WITH HIGH VOLTAGE. DISCONNECT SOLID-STATE SENSORS AND RELAYS PRIOR TO APPLICATION OF VOLTAGE TESTS.

5. Before energizing any part of the switchgear, make a complete check of the mechanical operation of all devices. Operate all circuit breakers and relays by hand and make sure there is no binding of moving parts.
6. Check continuity of all circuits. A great deal of this work can be done after the circuit breakers are installed by energizing the control source and operating the equipment with the main circuit dead. Indicating instruments check the continuity of current transformer and potential transformer circuits after the main circuit is energized.
7. Remove screws from short-circuiting strip on terminal blocks in current transformer circuits, and store in tapped holes in corners of blocks. Figure 18 illustrates such devices. Observe the listed precautions.

CAUTION CAUTION CAUTION CAUTION CAUTION

THE SECONDARY CIRCUITS OF ENERGIZED CURRENT TRANSFORMERS SHOULD NEVER BE OPEN CIRCUITED.



1. Special short circuiting screws in short circuiting position.
2. Grounding screw - DO NOT REMOVE.
3. Holes for storing short circuiting screws. See Connection Diagram for location. (Symbol ⏚)

FIGURE 18. SHORT CIRCUITING DEVICE

ASSEMBLED SWITCHGEAR FINAL INSPECTION

WARNING WARNING WARNING WARNING

THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. POWER, BOTH PRIMARY AND CONTROL VOLTAGES, MUST BE TURNED OFF BEFORE WORKING INSIDE THE EQUIPMENT.

After the switchgear and load circuits have been installed and all interconnections made, the assembled switchgear shall be given a final check and test before being put into service. This is necessary to insure that the equipment has been correctly installed and that all connections are completed. Extreme care must be exercised to prevent the equipment to be controlled from being connected to the system while the preliminary tests are being conducted. If disconnecting switches are not part of the apparatus or switchgear, the line leads should be disconnected to accomplish this.

If any covers for meters, relays, and other devices had been removed during the course of installation and test, they should be cleaned and promptly replaced to keep dust and dirt from collecting on vital or sensitive parts.

Check to ascertain that no foreign matter or tools have fallen into, left across bus, or been mislaid in the switchgear as a result of inspection and tests.

PLACING SWITCHGEAR IN SERVICE

The following procedure is recommended when putting the switchgear into service for the first time:

Control Circuit Checkout.

The preferred method to check the control circuit is to furnish a separate source of control power of the required control voltage rating. The separate source must have a properly coordinated backup circuit breaker in the circuit and set so as to clear any fault that inadvertently might occur. Initially all circuit breakers should be in the "DISCONNECT" position and the main power circuit de-energized. Stationary circuit breakers, if supplied, should be tripped open. Similarly, all control switches should be in the "TRIP" position. When ac control power is from the control power transformers in the switchgear, all fuses in the transformer circuits must be removed. On electrically operated circuit breakers, the motor disconnect switch should be in the "OFF" position.

PROCEDURE (Refer to IB 6.1.1.7-1 for circuit breaker instructions)

1. Connect the separate source to the control power circuit load terminals.
2. Energize the control circuit by closing the backup circuit breaker.
3. Rack one circuit breaker into the "TEST" position. The charging of the closing springs of an electrically operated circuit breaker will indicate that the control power is connected when the motor disconnect switch is placed in the "ON" position.
4. Rack the remaining circuit breakers into the test position.
5. Test each electrically operated circuit breaker for electrical closing and tripping by push-buttons, and/or control switches if furnished. Trip the circuit breaker by manually manipulating any electro-mechanical relays or protective devices. Utilize the Type 505 Test Set for testing the Solid-state tripping device.
6. Check interlocks. (Refer to IB 6.1.1.7-1)
7. Deenergize control circuit. If ac control power is from transformers in the switchgear, the external source of control power must be removed. Reinstall all fuses in the transformer circuit.
8. Close any compartment doors that may be open, and ascertain that all door panel screws are completely engaged.
9. Rack circuit breakers to "CONNECTED" position through the access port. All circuit breakers must be in the "OPEN" position. Close the access port.

Energizing the main bus

After completing the procedure for checking out the control circuit and circuit breakers, the switchgear main bus can be energized.

PROCEDURE

1. Energize the incoming bus to the switchgear main circuit breaker and observe if operation of instruments and relays is correct.
2. Re-energize separate control power source if furnished.
3. Close the main circuit breaker. The switchgear main bus is now energized. Observe if operation of relays and instruments is correct.
4. Close the desired feeder circuit breakers.

MAINTENANCE AND INSPECTION

General.

For continuing and satisfactory service, a periodic maintenance interval must be established and followed. More frequent maintenance intervals may be required if the switchgear is subject to highly repetitive operations and other than a clean atmosphere. Maintenance records listing conditions of switchgear, as well as any adjustments or replacements made, should be maintained as a guide for any special attention.

Perform visual inspection, front and rear, for evidence of loose parts, warping or undue vibration. Take steps to remedy any deficiencies of this nature that may appear. Inspect all anchor bolts and other structural bolts for tightness.

If leaks from overhead pipes and dripping from condensation or other sources cannot be eliminated, prevent the moisture from falling on the gear.

BBC
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WARNING WARNING WARNING WARNING

THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT POWER, BOTH PRIMARY AND CONTROL VOLTAGES, MUST BE TURNED OFF BEFORE WORKING INSIDE THE EQUIPMENT. WHEN A THOROUGH INSPECTION OR WORK IS REQUIRED ON A CIRCUIT BREAKER, IT MUST BE REMOVED FROM THE HOUSING. WHEN WORK IS TO BE DONE ON THE SWITCHGEAR, THE BUS SHOULD BE DEENERGIZED AND GROUNDED. WHERE SOLVENTS ARE CALLED FOR USE ONLY APPROVED SOLVENTS PER OSHA OR LOCAL REGULATIONS. A NON-FLAMMABLE SOLVENT WITH THRESHOLD LIMIT VALUE OF 300 PPM OR HIGHER IS RECOMMENDED. AVOID PROLONGED EXPOSURE TO SOLVENT VAPORS. USE SOLVENTS IN A WELL VENTILATED AREA.

6-18 Month Inspection.

1. Inspect primary interface connections (cable or bus) Discoloration, excessive corrosion or embrittled and discolored cable or support insulation may indicate an overheated connection. If found, follow the procedure described under the section SUSPECT JOINT MAINTENANCE.
2. Inspect primary cables and secondary wiring for chafing of conductor insulation.
3. Inspect secondary terminals for tightness of screws.
4. Examine resistors and other devices prone to overheating.
5. Clean the stationary portion of the switchgear by wiping with a clean cloth. A compressed dry air hose will be useful in relatively inaccessible areas.
6. Perform appropriate circuit breaker maintenance as described in manual IB-6.1.1.7-1
7. Remove covers of all panel devices where practical Check wiring for secure connections.Clean contacts on relays and switches. Replace covers.
8. Remove air filters when used, examine for dust content, and flush with water if necessary. After drying, recoat with R P. Super Coat Adhesive or equivalent, and replace
9. Inspect the gearing of the overhead lifting device when used. Keep well lubricated. For normal operation use a heavy gear lubricant. In very dirty or gritty conditions, it is advisable to use a dry lubricant, such as dry graphite.
10. Follow the recommendations of any individual device instruction data furnished for maintenance of the device.

18 Month-3 Year Inspection.

1. Clean stationary circuit breaker connection stabs in the enclosure with solvent. Inspect for evidence of excessive heat, arcing, or corrosion. If found, follow procedure described under the section SUSPECT JOINT MAINTENANCE.
2. Inspect secondary wiring bundles for signs of discoloration because of heat, chafing and embrittled or cracked insulation. Replace wire whenever doubtful.
3. Inspect primary insulation system for accumulated contamination. Clean insulation with dry cloth, dry air, vacuum,or if necessary, with solvent.

10 Year Maximum Inspection.

1. All primary conductor connection bolts should be torqued to recommended values (see Table 1). Experience indicates that thermal cycling, materials deformation and vibration effects can reduce tightness of hardware with consequential increase in resistance and heat developed.

   An alternative to retorquing may be use of infrared heat sensor (thermographic) techniques. These procedures are specialized, however, and require planning to overcome safety and loading difficulties.
2. Tighten all secondary control wire connections while checking for loose lug crimps and broken wire strands.

SUSPECT JOINT MAINTENANCE

1 Open joint and inspect connection surfaces.

2 Clean surfaces with solvent. Dress contact surfaces that show minor corrosion or pitting by lightly rubbing with polishing cloth such as 3-M SCOTCHBRITE; taking care to minimize removal of plating.

3. If heavy corrosion, arcing or melting has occurred, replace conductor parts.

4 Contact finger springs should be replaced after any exposure to excess heating at the breaker disconnect.

5. Contact surfaces should be protected with NO-OX-ID Special A compound (a product of SANCHEM CHEMICAL CO.) applied before assembly.

6. Use proper torque in tightening bolted connections (See Table 1).

CARE OF FINISH

The exterior finish of switchgear should be kept clean at all times. Wiping with a clean dry cloth will usually suffice To remove oil and grease marks, use warm water and soap, wiping dry with a soft cloth. To touch up the exterior or interior finish after final erection use Randolph Touch-up Finish (Randolph Product Co., P.O. Box 67, Carlstadt, NJ 07072) of the corresponing color. The color finish furnished on the exterior varies, and this information is stated on the front sheet of the switchgear Bill of Material.

RENEWAL PARTS

Refer to renewal parts bulletin RP 6.1.1.8-1 for complete ordering information and parts list. A copy of this bulletin will be furnished on request.