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Installation, Inspection and Maintenance of Switchgear

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1. General

As per SANS 10086-2, mines should have Code of Practices (COP) in place to ensure correct selection, installation and maintenance of equipment used in mines. This document is an extension of the mine's COP and should be incorporated within the mine's COP.

This document covers the following:

- Installation of switchgear
- Scheduled inspection, which shall be carried out regularly
- Scheduled maintenance and overhaul program, which shall be carried out periodically
- Operating procedure

2. Installation

Switchgear applications in mines are exposed to severe conditions. It is therefore essential to ensure equipment ratings and protection settings are observed and that maintenance is strictly carried out to safeguard mine personnel, operating staff and equipment.

The following points must be taken into consideration:

- a. Equipment ratings
Equipment used in the switchgear is properly rated to withstand the full fault current and transient surge voltages.
- b. Clearances
Bus-bars, circuit breakers, contactors, cable connections etc. Have adequate clearance and insulation as per the specific recommendations.
- c. Interlocks
Both mechanical and electrical interlocking is provided on all panel doors and where possible on all inspection covers.
- d. Sharp protrusions
Sharp metal protrusions shall be avoided where any insulation can sustain damage.
- e. Cable securing devices
Any cable securing device or method that damages insulation in any way should be strictly avoided.
- f. Ionization
During power switching devices such as circuit breakers and contactors, air is ionized and therefore adequate clearances are provided and should be strictly adhered to and not compromised in any way.
- g. Protection settings
Protection settings shall be configured and set for the specific installation.
- h. Drawings
Electrical and mechanical layout drawings for switchgear are available to allow for easy identification of components and their connection details.
- i. Switchgear enclosures
The enclosure complies with the required standards.
- j. Cable connections / terminations
All cable couplings, connections and terminations shall be properly secured and the earth continuity maintained with the switchgear enclosure.



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- k. Approval certification
Ensure that all inspection authority approval certificates and test reports are available and filed and that the correct explosion protected approval has been given for the hazardous area in which the equipment is to be used.
- l. Internal components
Once the switchgear has been positioned open all panel doors and inspection covers to ensure the internal components, cable and connections are in place secure and free from damage.
- m. Busbar connections
Ensure that all bus bar cable box connections are secure.
- n. Insulation tests
Before energisation the following insulation tests shall be conducted. The incoming and outgoing phase leads, between phases and each phase to earth. (Ensure any electronic instrumentation is disconnected if necessary to prevent any damage during testing.)

NOTE: INSULATION TESTING SHOULD BE CARRIED OUT WITH AN APPROVED TESTER AND TESTING SHOULD BE DONE AS PER A SPECIFIC MINE STANDARD



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3. Safety Inspections

Critical safety inspections shall be carried out prior to energisation of the switchgear.

Ensure the switchgear is located in a clean and dry location where the roof and sidewalls are in good condition and which is clear of moving traffic. The location should be such that the accumulation of dust and water is minimized.

- a. Ensure that switchgear is located in a clean, dry location where the roof and sidewalls are in good condition and which is clear of moving traffic. The location should be such that the accumulation of dust or water is minimized.
- b. Ensure that adequate space is allowed around the switchgear to provide the following:
 - b.1. Unobstructed ventilation around the switchgear.
 - b.2. Easy installation and removal of incoming and outgoing cables.
 - b.3. Uninhibited access to the switchgear and in particular operating handles, push buttons, emergency stops, inspection covers, access covers and doors.
 - b.4. Free visual access to inspection windows, inspection lamps and switchgear labelling.
 - b.5.
 - Confirm the integrity of the neutral earth resistor (if applicable)
 - Confirm the integrity of all back tripping circuits, ie doors, cover, short circuit back trip provisions and any further electrical interlocks.
- c. Ensure that all incoming and outgoing adaptors and sockets are clean, free from damage and are secure.
- d. Ensure that any drain or blanking plugs fitted are in place and are secure.
- e. Ensure that any instrument glassed and inspection windows are intact.
- f. Ensure that all panel doors, inspection and access covers are in place and correctly secured by the specific bolts, which are proper and uniform size, type and are tight.
- g. Ensure that all covers over set/reset buttons etc, are fitted and secure.
- h. Ensure that the earth bonding of equipment complies with specific mine requirements
- i. Ensure that the firefighting and statutory notices are available, legible and in place that the correct explosion protected approval mark is displayed for the hazardous area in which the equipment is used.
- j. Carry out any other checks or test required by the mines standards.

Once the above operations have been carried out satisfactorily the incoming and outgoing cables can be connected. Ensure that the cables are suitably anchored and positioned so as to prevent undue tension or twisting of the cable under operating conditions. Once this is done the electrical supply can be energized.



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4. Safety Inspections after Equipment Energized

The following critical safety inspections will be carried out after energisation.

- a. Ensure the correct operation of the earth leakage trip and earth fault lockout protection
- b. Ensure the correct pilot operation (if applicable)
- c. Ensure all live line indicators are operational
- d. Check the correct operation of the assembly
- e. Ensure adequate lighting is available to allow for the reading of labels and location of operating handles and push buttons.
- f. Installation of inspection records
All installation and inspection results of tests performed shall be recorded and filed for future reference and inspection.
- g. Log book
A log book should be provided to record all switching operations, isolations and trip occurrences.



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5. Scheduled Inspections

The frequency of regular inspections shall be in accordance with mine specific procedures.

- a. Ensure that the switchgear is free from obstruction and accumulation of dust, dirt or water and the surface temperature is not unduly hot.
- b. Ensure the tap change cover is secure
- c. Ensure that all inspection covers, access, doors, plug and socket fastening bolts are in position and tight.
- d. Check the conditioning of incoming and outgoing cables. Ensure that there is no twisting, undue tension or sharp bends that the cable is secure in the glands.
- e. Ensure that all statutory notices and firefighting appliances are provided and in position.
- f. Ensure that all earth bonding is fitted and securely attached.
- g. Ensure that the logbook is available and correctly utilized.
- h. Perform any other inspections advised by the mines specific requirements.



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6. Maintenance

Two types of maintenance programs should be in place.

6.1. Scheduled Maintenance

Note: Ensure correct isolation of equipment as per the mines specific lockout procedures before attempting to open any covers or remove any incoming and outgoing cables.

- a. Ensure that the switchgear is free from obstruction and accumulation of dust, dirt or water and the surface temperature is not unduly hot.
- b. Ensure the tap change cover is secure
- c. Ensure that all inspection covers, access, doors, plug and socket fastening bolts are in position and tight. All flameproof paths must be clean, free of rust and comply to the specific requirements.
- d. Check the conditioning of incoming and outgoing cables. Ensure that there is no twisting, undue tension or sharp bends that the cable is secure in the glands.
- e. Ensure that all statutory notices and firefighting appliances are provided and in position.
- f. Ensure that all earth bonding is fitted and securely attached.
- g. Ensure that the logbook is available and correctly utilized.
- h. Perform any other inspections advised by the mines specific requirements.

6.2. Scheduled Major Overhaul

In order to facilitate major overhaul, the switchgear should be removed from service and taken to a workshop environment.

- a. Perform all checks under scheduled inspection.
- b. Ensure that all internal parts are secure on their mountings and all cable and bus bar connections are secure.
- c. Inspect all cable connections for signs of overheating.
- d. Inspect bus chamber, main enclosure, cable boxes and bus bar interconnections for signs of overheating.
- e. Ensure all contacts are making good electrical contact and show no signs of overheating.
- f. Ensure that all arc shields etc. are in position and in good condition.
- g. Ensure that all overload, short circuit trips and earth leakage trips are set correctly for duty.
- h. Ensure that all indication is in order and operating correctly.
- i. Clean the interior.
Uses only approved cleaning agents and ensure that the area around the cleaning operation is well ventilated. (Some oil based water displacement sprays attack certain plastic materials and the oil residue allows coal dust to accumulate, which could compromise design creep age distances).
- j. Ensure that all mechanical operations and interlocks are operative.



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- k. Ensure all fuses are to the correct size and type and are intact and secure in their holders.
- l. Ensure that the voltage tap settings of control transformer are in accordance with the supply voltage and required control voltage.
- m. Ensure all cable insulation is clean and in good order and perform insulation tests on phase cables.
- n. Ensure the isolator compartment is clean, all connections are secure and that there are no signs of overheating.
- o. Ensure all back tripping and electrical interlocking is operative.
- p. Ensure all push buttons are operative and not sticking.
- q. Ensure that the vacuum circuit breakers are not damaged and there is no loss of vacuum. Inspect circuit breakers in accordance with the manufactures recommendations to ensure that the service life and duty has not been exceeded.
- r. Check that all incoming and outgoing sockets are free from damage, dust or moisture.
- s. Inspect any densely packed cable trucking and take specific notice around the vicinity of any tight strapping together of cables such as run locks for signs of overheating or damage.
- t. Inspect any bushings to ensure they are clean and free from damage.
- u. Perform any other maintenance and tests advised by equipment manufacturers or mine specific requirements.
- v. All periodic inspection and results of tests performed shall be recorded and filed for future reference
- w. Remove the switchgear internal equipment from its enclosure:
 - Remove any rust, dust or moisture from the enclosure. Special attention should be given to the inside corners which can be susceptible to a buildup of powder and rust which can impair the integrity of the enclosure.

All maintenance and test results should be recovered and filed for future reference and inspection.