

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

OUTDOOR COMPACT SECONDARY SUB-STATION



NQube

ENSURE SAFETY AT ALL TIMES

WARNING! If you are in doubt, do not proceed. Call E&A personnel for technical support. At all times adhere to the instruction and manual for safety and always follow the local regulatory requirements and best safety practices. Hazardous voltage can cause electrical shocks and may be fatal. Disconnect all power supplies and then earth all the equipment before proceeding.

This instruction and operation manual adheres to strict safety regulation and is recommended for users to follow this instruction manual for safe working and operations of their equipment.

For the best results carefully read this manual and all the warning labels attached to the instrument before installing and operating it and follow the instructions exactly. Keep this manual handy for quick reference.

1. This equipment should be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could be fatal.
2. Comply to international & local standards, local electrical utilities regulations for safe working practices
3. This instruction manual along with annexure (if any) should be made accessible to all personnel involved in installation, operation and maintenance.
4. Pay special attention to the hazard notes in the instruction manual.
5. Make sure that the instrument and tools rated for the voltage and current specified are used.
6. Observe the relevant information in the instruction manual for all actions involving switchgear and switchboards. When you are in doubt refer the instruction manual or call E&A service team.
7. All personnel using the equipment must be responsible upon all matters relating to the safety at work and correct method of handling the switchgear.

For any further questions or enquiries relating to this instruction manual or our equipment in use please refer to our service team in E&A. We are pleased to provide further assistance relating to our equipment.

E&A reserves the right to this publication. Misuse and publication of this manual – or extracts thereof available to third parties is prohibited. E&A will not accept liability or responsible for any information provided which is subject to alteration.

ABOUT THESE INSTRUCTIONS

These instructions do not support to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation or operation.

For details about technical design and equipment like e.g. technical data, secondary equipment, circuit diagrams, please refer to the order documents.

The switchgear is subject to continuous technical development within the scope of technical progress. If not stated otherwise on the individual pages of these instructions, we reserve the right to modify the specified values and drawings. All dimensions are given in mm.

For further details, e.g. about additional equipment and information about other switchgear types, please refer to E&A's product catalogue.

Should further information be required or should particular problems arise which are not covered sufficiently in these instructions, the matter should be refer to E&A.

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of E&A. The warranty contained in the contract between the parties is the sole warranty of E&A. Any statements contained herein do not create new warranties or modify the existing warranty.

GENERAL INSTRUCTIONS

Independent of the safety instructions given in these operating instructions, the local laws, ordinances, guidelines and standards for operation of electrical equipment as well as for labour, health and environmental protection apply.

Any kind of modification on the product or alteration of the product must be coordinated with the manufacturer in advance, as uncoordinated modifications or alterations can cause the expiration of warranty claims, cause danger to life, limb and other legally protected interests, and the fulfilment of the type tests (according to relevant IEC standards) may not be guaranteed anymore.

The edition of the standard is only mentioned in the test report applicable at the time of switchgear manufacture.

Our equipment is subjected to factory inspection and testing according to the applicable standards and provisions.

The correct function and the service life of the switchgear are influenced greatly by compliance with the installation, commissioning and operating conditions stipulated in this manual. Non-compliance with these provisions may compromise warranty claims.

Any local provision which does not contradict the specifications of this document, especially as regards safety for personnel and buildings, must be complied with.

E&A cannot be held liable for the possible consequences of:

- Non-compliance with the provisions contained in this manual, which refer to international regulations.
- Non-compliance with the instructions of the suppliers of cables and connecting accessories as regards application and installation.
- Any aggressive climate conditions (humidity, pollution etc.) prevailing in the immediate environment of switchgear not suitable to this effect or not protected accordingly.
- Non-compliance with the standard maintenance period.

SPECIAL INSTRUCTIONS FOR OPERATIONS AND ANY INTERVENTION WITH ENERGISED EQUIPMENT

When commissioning and operating switchgear equipment under normal conditions, the general electrical safety instructions (gloves, insulating stool, etc.), as well as operation handling instructions should be adhered.

All circuit breaker, disconnecting switch, interlocks operation must be completed once started.

This manual does not contain any instructions regarding the mechanical lock-outs to be performed. The work described is performed on de-energised (on installation) or mechanically locked-out (de-commissioned) switchgear.

FIVE SAFETY RULES OF ELECTRICAL ENGINEERING

The Five Safety Rules of Electrical Engineering must generally be observed during operation of the products and components described in these operating instructions:

- Isolate.
- Secure against reclosing.
- Verify safe isolation from supply.
- Verify earth fault and short-circuit.
- Cover or barrier adjacent live parts.

DUE APPLICATION

The switchgear corresponds to the relevant laws, prescriptions and standards applicable at the time of delivery. If correctly used in the right environment they provide a high degree of safety by means of logical mechanical interlocks and shockproof metal enclosure of live parts.

The perfect and safe operation of this switchgear is conditional on:

- Observance of operating and installation instructions.
- Qualified personnel.
- Proper transportation and correct storage of the switchgear.
- Correct installation and commissioning.
- Diligent operation and maintenance.
- Observance of the instructions applicable at site for installation, operation and safety.

QUALIFIED PERSONNEL

Qualified personnel in accordance with these instructions are persons who are familiar with transportation, installation, commissioning, maintenance and operation of the product and have appropriate qualification for their work.

Furthermore, qualified personnel must have the following training and instruction or authorization:

- Training and instruction or authorization to switch on, switch off, earth and identify power circuits and equipment / systems as per the relevant safety standards
- Training and instruction regarding the applicable specifications for the prevention of accidents and the care and use of appropriate safety equipment
- Training in first aid and behavior in the event of possible accidents

NORMAL OPERATING CONDITION

AMBIENT AIR TEMPERATURE

- Minimum air temperature: -10°C
- Maximum air temperature: $+50^{\circ}\text{C}$
- Maximum 24 hrs average $< 35^{\circ}\text{C}$

AIR HUMIDITY

- The average air humidity measured over a period of 24hrs must not exceed 95%.
- The average air humidity measured over a period of one month must not exceed 90%.

INSTALLATION ALTITUDE: Normally upto 1000m. At higher altitudes, the reduced voltage endurance must be taken into account.

SOLAR RADIATION: Solar radiation up to a level of $1000\text{W}/\text{m}^2$ (on a clear day at noon) should be considered.

WIND SPEED: The wind speed does not exceed $34\text{m}/\text{s}$.

IDEAL ENVIRONMENTAL CONDITION

- Air humidity $< 40\%$ and no dripping water
- Minimal dust and air circulation
- No contact with any chemical agents and free from plant and animal infestations.
- No vibration due to causes external to the switchgear and controlgear or earth tremors.
- The unit must be free from any kind of damage, whatsoever caused by external factors.

STANDARD ENVIRONMENTAL CONDITION

- Unit must not be subjected to regular extremes of weather like heavy rain storms, dust storms, heavy snow and ice, flooding, temperature cycle beyond prescribed level, dense coastal fog or acid rain.
- No regular or thick covering of leaves or other debris.
- No contact with any chemical agents and free from plant and animal infestations.
- No vibration due to causes external to the switchgear and controlgear or earth tremors.
- The unit must be free from any kind of damage, whatsoever caused by external factors.

For special cases and requirements, please contact the E&A sales personnel nearest to your region

CONVENTIONAL SYMBOLS



CAUTION

Remain vigilant! Precautions to be taken in order to avoid any accident or injury.



FORBIDDEN

Do not do it! The compliance with this indication is compulsory, noncompliance with this stipulation may damage the equipment and/or compromise the safety



DANGER

Do not do it! The compliance with this indication is compulsory, noncompliance with this stipulation may cause serious injury or can be fatal.



INFORMATION

ADVICE! Your attention is drawn to a specific point for installation or operation.

Tools and maintenance products (not supplied) necessary for operations described in this instruction manual

Cutter	Torque wrench with sockets size 13; 16; 18 and sockets for hexagonal screws size 12
Crow Bar	Flat blade screwdriver
Open-ended spanners size 8; 13; 16; 18	Torque T25 screwdriver
Adjustable spanner	Cutting pliers
Ratchet wrench with socket sizes 7; 8; 10; 13; 17; 19; 24	Slings
Allen keys for hexagonal screws size 8; 10; 12	Grease for electrical contacts

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1.0 INTRODUCTION

This manual describes the fundamental handling, operation & maintenance of the N-Qube Compact Substation and its standard handling procedures. N-Qube are compact substation used for Medium Voltage Power Distribution ideally installed in areas where free space is major constraint.



Figure 1: Compact Secondary Substation

2.0 SPECIFICATIONS

TECHNICAL DATA

Table 2.1: Technical data for CSS

		IEC-62271-202	
Panel Details	Standards	IEC-62271-202	
	CSS Enclosure Type		Non-Walk in
Voltage ratings	Rated Voltage	kV	12*
	Power Frequency Withstand Voltage	kV (rms)	28*
	Impulse Withstand Voltage (1.2/50 µsec)	kVp	75*
	Frequency	Hz	50 / 60
Current ratings	Rated Current	A	630
	Rated Short Time Withstand Current (3s)	kA	21
	Rated Short Circuit Breaking Current	kA	21
	Rated Short Circuit Making Current	kAp	52.5 / 54.6
	Internal Arc Withstand	kA	21
HT Compartment Technical Details	Voltage	kV	12*
	Degree of Protection		IP 54
Transformer Technical Details	Type		Oil Hermetically Sealed / Dry Type
	Power Rating Upto	KVA	1250**
	Degree of Protection		IP 23D
LT Compartment Technical Details	Voltage	V	Upto 440
	Short Circuit Protection Device		ACB / MCCB / Switch Fuse
	Degree of Protection		IP 54
	Power Factor Compensation		Available on Request
Interconnection	Between RMU and Transformer		Cable
	Between LT Switchgear and Transformer		Busbar

* Higher Voltages on request

** Higher Transformer Rating on request

Table 2.2: Technical data for disconnecting & load break switch

Disconnecting Switch	
Operating method	Motor-spring/ Manual-spring operation
Operation voltage	110 VDC**
Interlock coil voltage	110 VDC**
Mechanical operation life	1000 Operations

* 25kA internal arc rating available on request

** Other voltages available on request

Table 2.3: Technical data for vacuum circuit breaker

Vacuum Circuit Breaker	
Operating duty	O-0.3s-CO-3 min-CO
Power rating of motor	275 W
Power motor spring charging	< 200 W
Spring motor charging time	< 10 sec
Power to release closing/tripping spring	< 275 W Closing spring release by solenoid coil
Mechanical life	10000 Operations

Table 2.4: Standards

Mainly applicable standards	
IEC 62271-100	Vacuum circuit breaker
IEC 62271-200	Cubicle
IEC 62271-102	Isolator/disconnector
IEC 62271-103	Load break switch
IEC 60376	Specification of SF6
IEC 60480	Checking & treatment of Sf6
IEC 62271-202	Outdoor Enclosure

3.0 STRUCTURAL DETAILS AND GENERAL ARRANGEMENT

3.1 GENERAL ARRANGEMENT

N-Qube is a type tested assembly comprising of an enclosure containing a medium voltage switchgear preferably RMU, a distribution transformer, a low voltage equipment, interconnections and auxiliary equipment to transform energy from medium to low voltage systems.

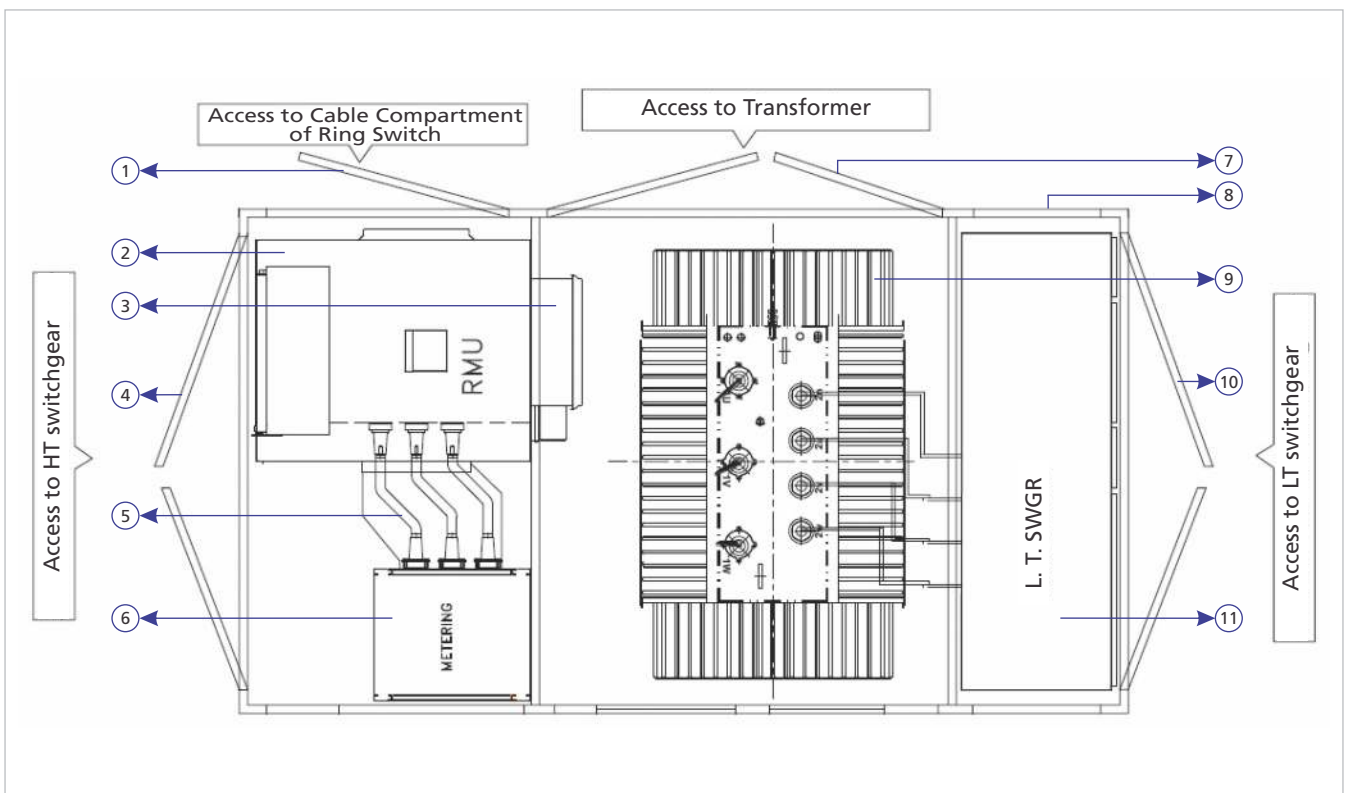


Figure 3.1: General arrangement for typical CSS

- | | |
|--|----------------------------|
| 1. RMU Cable Termination Access Door | 7. Transformer Access Door |
| 2. Ring Main Unit | 8. CSS Enclosure |
| 3. T-off Cable termination Compartment | 9. Transformer |
| 4. MV & Metering Panel Door | 10. LV Panel access Door |
| 5. RMU & Metering Coupling Busbar (optional) | 11. LV Panel |
| 6. Metering Panel (optional) | |

3.2 ENCLOSURE

- N-Qube is built with outdoor type dust and vermin proof enclosure.
- Modular construction of Galvanised Sheet Steel provides Rust, corrosion and weather proof operation.
- All equipment are mounted on a common Galvanised ISMC base frame.
- Each Compartment is provided with separate door and padlocking arrangement.
- Each Compartment is fitted with panel illumination lamp with door operated switch.
- Transformer Door is provided with louvers which allows cross ventilation for natural cooling.



Figure 3.2.1: CSS Enclosure

3.3 MEDIUM VOLTAGE COMPARTMENT

- The MV Switchgear Compartment of N-Qube is equipped with E&A Make SF6 insulated GR1 VI Type RMU with side cable entry and rear tee-off bushings which helps in direct and easy coupling of RMU with transformer.
- E&A GR1 VI is equipped with Stainless Steel Make completely sealed SF6 Tank, Load break Switch and Vacuum Circuit Breakers with self-powered relay for Transformer Protection.
- E&A GR1 VI is designed and tested for Internal Arc of up to 21kA for 1 sec.
- Optional Metering Unit can be offered on request inside MV Compartment.
- SCADA Compatibility through Remote terminal Unit is possible on request.
- Conforming Standards: IEC62271-1, IEC62271-100, IEC62271-200, IEC62271-102, IEC62271-103, IEC62271-202, IEC60529



Figure 3.3: MV compartment

3.4 TRANSFORMER COMPARTMENT

- The Transformer compartment of N-Qube is specially designed to provide transformer with sufficient volume of airflow for cooling through adequately sized louvers on door.
- Wire mesh is provided inside these doors to achieve required Ingress Protection level.
- Option to accommodate either Oil Immersed or Dry Type transformer.
- Winding and Oil temperature monitored through MV Compartment mounted OTI and WTI.
- Fire extinguisher and Smoke detector can be offered optionally.
- Conforming Standards: IEC62271-202, IEC60076-2, IEC60529



Figure 3.4: Transformer Compartment

3.5 LOW VOLTAGE COMPARTMENT

- LV Compartment of N-Qube consists of Low Voltage Distribution Board which is fed from secondary side of transformer.
- LVDB can be designed in different arrangements and configurations in order to suit any specific application.
- Sleeved Busbars are provided for phases and neutral suitable to transformer secondary voltage and Short circuit level.
- Switching devices such as ACB's, MCCB's or Fuse switches can be accommodated.
- Capacitor panel with automatic power factor regulation rated as per transformer rating can be provided on request.
- Conforming Standards: IEC62271-202, IEC61439-1, IEC60529



Figure 3.5: Low Voltage Compartment

3.6 INTERCONNECTIONS

- Primary connection from transformer is done via XLPE cable and secondary connection by solid flats of Copper / Aluminium.
- Cable Connection between RMU and Transformer as well as Bus bar connection between LT Panel and Transformer accessible through Transformer door (interlocked with RMU).



Figure 3.6: Interconnections

3.7 GAS PRESSURE INDICATOR

The RMU tank is sealed with SF6 gas at rated pressure of 0.5 bar (relative pressure) @ 20 deg. C, which is continuously monitored by gas pressure indicator.



Figure 3.7.1: Gas Pressure Indicator

The safe permissible Gas pressure range is between 0.25 to 0.5 bars @ 20 deg. C (Pointer should be within Green Zone as shown in the Figure 3.6).

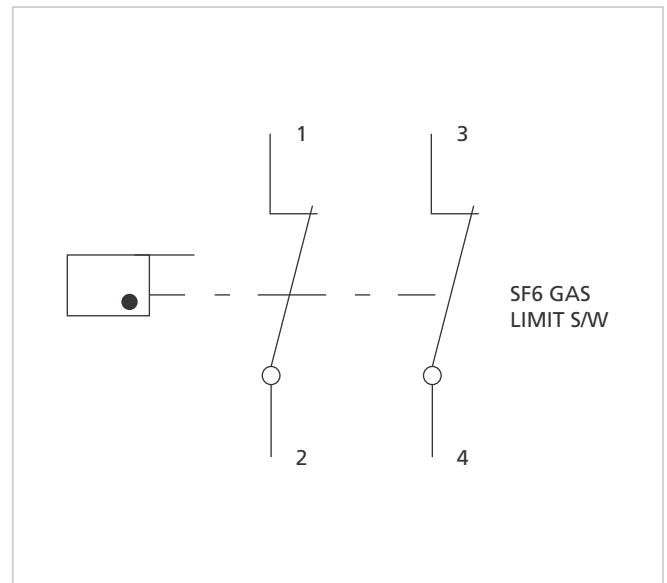


Figure 3.7.2: Normally closed switching contact

The following optional features are available on request

- The Gas Density Monitor is available with maximum two magnetic snap action switching contacts. These contacts can be normally close (NC) or normally open (NO).
- These 2 contacts can be used for alarm and tripping purpose. At 0.25 bar the alarm starts & at 0.20 bar tripping occurs
- Local readout with alarm contacts.
- Temperature compensated.

- Winding and Oil Temperature can be continuously monitored through MV Compartment mounted OTI and WTI. Two Contacts are available to be wired out for Alarm contacts or Breaker Trip as per requirement.



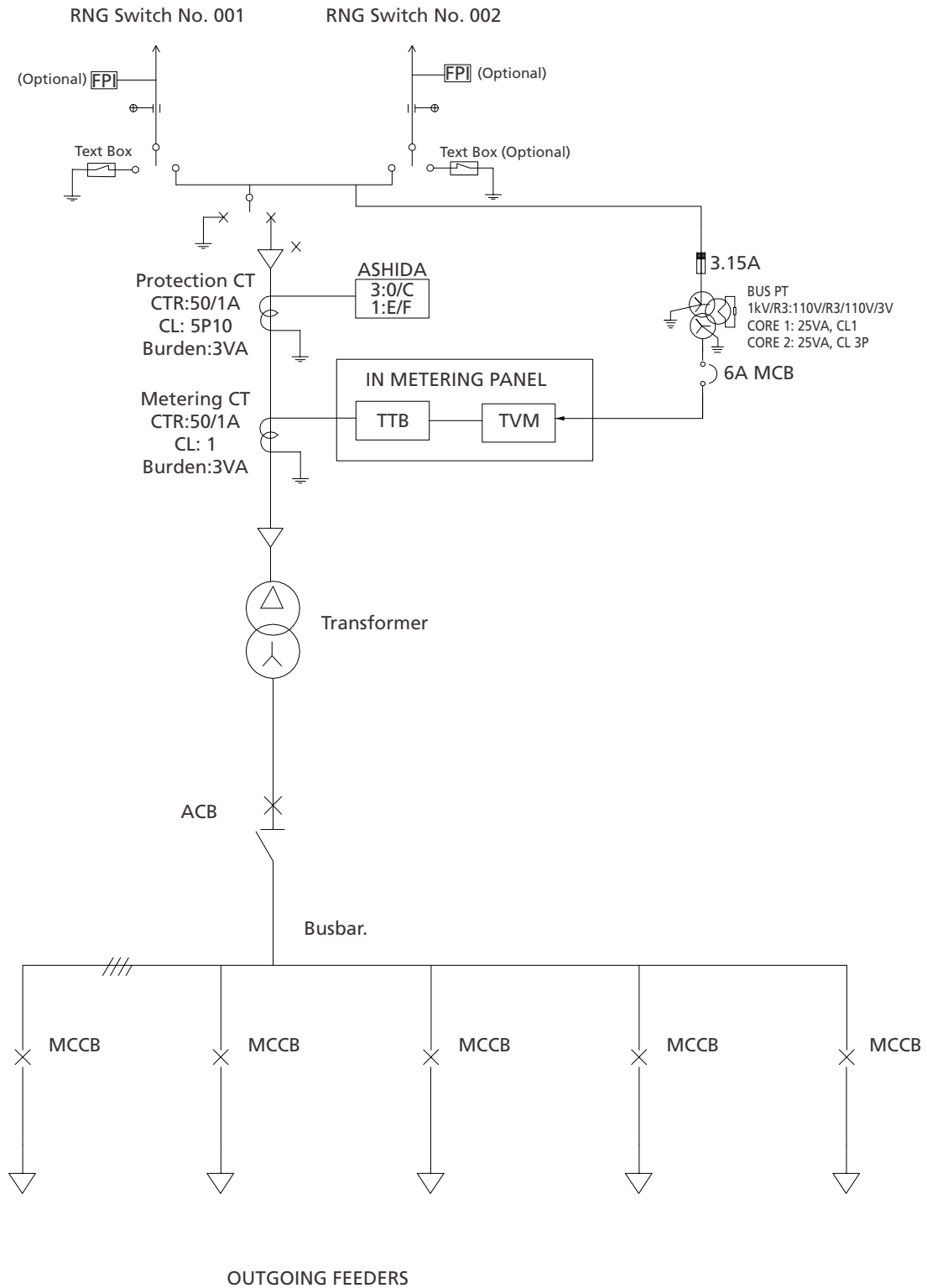
Figure 3.7.3: WTI and OTI

- Fault Passage Indicators (Optional) can be offered in incomer LBS of RMU. FPI makes it possible to detect short circuits, earth faults and makes it easier to identify cable faults.



Figure 3.7.4: Fault Passage Indicators

3.8 TYPICAL N-QUBE ARRANGMENT



4.0 HANDLING AND STORAGE

4.1. PRECAUTIONS TO BE TAKEN

4.1.1 - Safety Aspects

- The CSS are designed for outdoor application with all required safety features.
- Before carrying out any installation, operation and maintenance, the service person should be fully acquainted with the relevant safety regulations covering this equipment as well as with the inside of the substation.
- Check that the personnel operating the apparatus have this instruction manual with them.
- Installation and commissioning should be carried out by qualified and authorized personnel.
- Ensure compliance of local (site) legal and safety norms.

4.1.2 - Transportation & Unloading

- The substation is transported unpacked. For longer distances, we use protective measures such as wooden corners, plastic film, etc. are to be used. (with plastic)
- Separate Wooden Base is not required as ISMC base is suitable for lifting and transportation.
- Local Transport is done on open truck and for export same is done in open top containers.
- N-Qube is transported with Distribution Transformer factory fitted inside the transformer compartment.
- Remove all packing materials before installation.
- During transport the substation is to be firmly fixed to the truck in the following way to avoid any damage in transit.

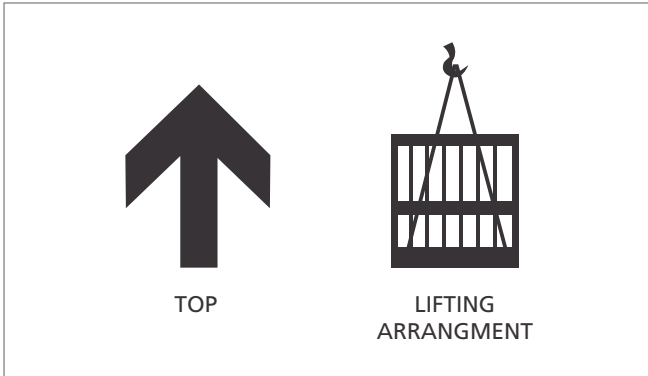
- Arrangement for fixing on truck
- On receipt at site, the CSS has to be lifted and placed on the concrete foundation
- Lifting hooks are installed on the bottom side of CSS
- CSS shall be lifted with the provided arrangement with the help of Crane.
- During Lifting CSS shall not be tilted more than 3 degrees.
- N-Qube is designed suitable for lifting entire assembly with transformer pre-installed.



Figure 4.1.2.1: CSS on Truck



Figure 4.1.2.2: Lifting Method Of CSS



- Unloading of CSS shall be done as per Instruction stickers given CSS.
- CSS shall be unloaded with sufficient capacity of crane or Hydra. If unloading is done with wire ropes, fit lifting ropes of appropriate load capacity with shackles and ensure that lifting hooks are locked properly.
- Transport CSS upright only. Carry out loading operations only when it has been ensured that all precautionary measures to protect personnel and materials have been taken and using a
 - Crane
 - Fork lift and/or
 - Manual Trolley Jack and rollers
- Never tilt the crates over as shown below. Non Compliance with this stipulation may damage the equipment. Always keep it upright.

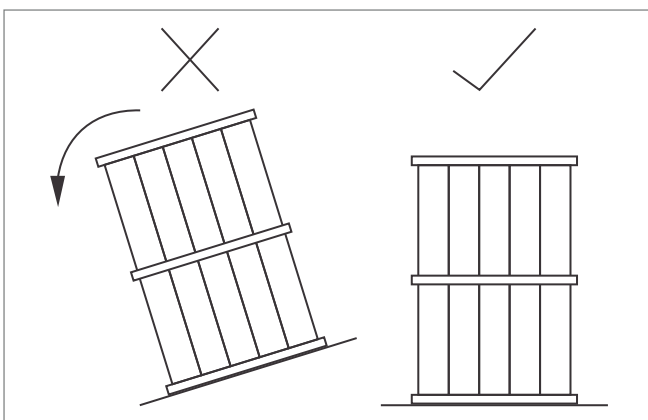


Figure 4.1.2.3 - Crate positioning

i **INFORMATION** - Use of fork lift trucks for jacking or placing the jacks other than as described may result in stress distortions and irreparable damage to the equipment.

⊘ **FORBIDDEN** - Do not remove the shipping bases until the units are set in place. Moving the units without the shipping base will cause irreparable damage and a hazardous condition.

4.2. PACKING AND UNPACKING

4.2.1. Shipping Condition

Generally, each CSS is supplied along with complete Packing List in which major items are as follows:

1. RMU
2. Transformer
3. LT Panels
4. Compact Substation enclosure assembly
5. RMU Operating Handle
6. Interconnecting Cables / Links
7. Loose Castle Keys
8. Allen Key

4.2.2. Precautions for Unpacking

- Upon arrival at site, the consignment shall be unpacked within one (1) week and checked against the packing list or the delivery note.
- In case of shortage in supply or damage to the items, report the same within two (2) weeks, accompanied with a full description/ photographs of the missing/damaged parts. Any delay in making the claims will not be entertained.

i **INFORMATION** - All doors must be closed and securely fastened before moving the panels to prevent damage.

4.3 STORAGE

The type of packing depends on the duration and nature of storage.

The standard cubicle packing is meant for indoor storage where there is no possibility of condensation. If the equipment after being unpacked is to be left as it is or stored for some period of time until the installation commences or the equipment after having been installed is left idle. The cubicle should be covered to avoid contamination on cubicle surface.



Figure 4.3 - Storage condition

Although the CSS is meant outdoor operation, it is advisable to be stored in a clean, dry and well-ventilated environment before installation & commissioning.

The storage area must shelter the equipment from deterioration by agents like

- Water
- Water Vapour
- Salt Laden air
- Pollution of any type
- Micro-organisms

Store CSS standing upright.

Do not stack CSS board.

If the substation is to be stored for a long time outdoor, it is recommended that it is placed on a flat surface so that it is supported in the same way as in normal situation.



DANGER - Do not walk on the roof of the CSS. May cause personnel injury and damage to panel.

4.4 - Intervention Levels

Definition	Level		
	1	2	3
Operations carried out by the client	1		
Operations requiring training and which can be performed by an approved third party		2	
Work which can only be carried out by E&A			3

4.5 - INSTRUCTION FOR STORAGE PERIOD BETWEEN 0 AND 6 MONTHS

Wrapped under plastic film	1	2	3
Packaging should be periodically inspected	X	X	X
When the equipment is unpacked	X	X	X
10-12 times manoeuvres should be carried out in order to check the mechanical operation of the equipment		X	X
The minimum threshold (85% of Un) of the coil electrical operation should be tested		X	X

4.6 - INSTRUCTION FOR A STORAGE BETWEEN 6 AND 12 MONTHS PERIOD

Wrapped under heat sealing cloth with desiccant bags	1	2	3
Packaging should be periodically inspected (absence of any perforation amongst others)	X	X	X
When the equipment is unpacked : slightly dilute the dry greases with neutral paraffin oil		X	X
10-12 times manoeuvres should be carried out in order to check the mechanical operation of the equipment		X	X
The minimum threshold (85% of Un) of the coil electrical operation should be tested		X	X

5.0 INSTALLATION

5.1 GENERAL

It is a must to consult all drawings furnished for the particular order before the commencement of installation. The drawings provided to the customer order generally covers the following things:

- Top, front and section views of the CSS
- Primary and secondary connection diagrams
- Bill of materials

Study the base frame drawing before preparing the site plan drawing. On commencement of installation on site, the CSS installation area must be completely finished, provided with lighting and the electricity supply, be lockable, dry and have facilities for ventilation. All the necessary preparations, such as wall openings, ducts, etc., for positioning the power and control cables up to the CSS must already be complete.



FORBIDDEN - Alteration of equipment like drilling, punching, cutting, filing etc. operation may compromise with the internal arc safety. Consult E&A before commencement of such action (if any required)

5.2 CHECKS PRIOR TO INSTALLATION

Check the external dimensions of the cubicle and foundation frame according to the drawing provided.

5.3 GENERAL SITE REQUIREMENTS

E&A supplies relevant drawings like general arrangement, floor

plan etc. Refer these drawings for foundation preparation, floor plan. Foundation frame is not in the scope of E&A supplies and generally its requirement varies from customer to customer. Some customer even do not use foundation frame for installation. This section provides the typical example for the purpose of guidance only.

When installing a CSS local building regulations have to be followed. The instructions and proposals stated in this instruction have to be adjusted as per building regulations.

In order to avoid problems with final alignment of the doors, it is important that the foundation is prepared properly. The local soil conditions and possibility of the ground settlement should also be considered. The foundation has to be made sufficiently deep so that sinking of the base due to frost, rain (humidity) or drought is avoided, thus, making final alignments easier.

Depending on the site topography, design the support required for the foundation (gravel, concrete plinth or plinth and pile foundation). For locating the sub-station on difficult terrains, the substation should be mounted on a concrete base (accessory or site cast), and in extreme conditions the base should be set on pile foundation.

Following checks are to be carried out on the site cast concrete foundation.

- Location of cable trenches (HV & LV) with respect to the General Arrangement Drawing.
- Location and size of the foundation bolts provided.
- Earthing bar location
- Adequate Earthing.

5.4 FOUNDATION

Holes for foundation bolts should be in accordance with the contract arrangement drawings. A typical arrangement of the foundations and cable entries for standard CSS is shown in figure.

NOTE : FOUNDATION PLAN MAY CHANGE AS PER CUSTOMER REQUIREMENT DURING DETAIL ENGINEERING.

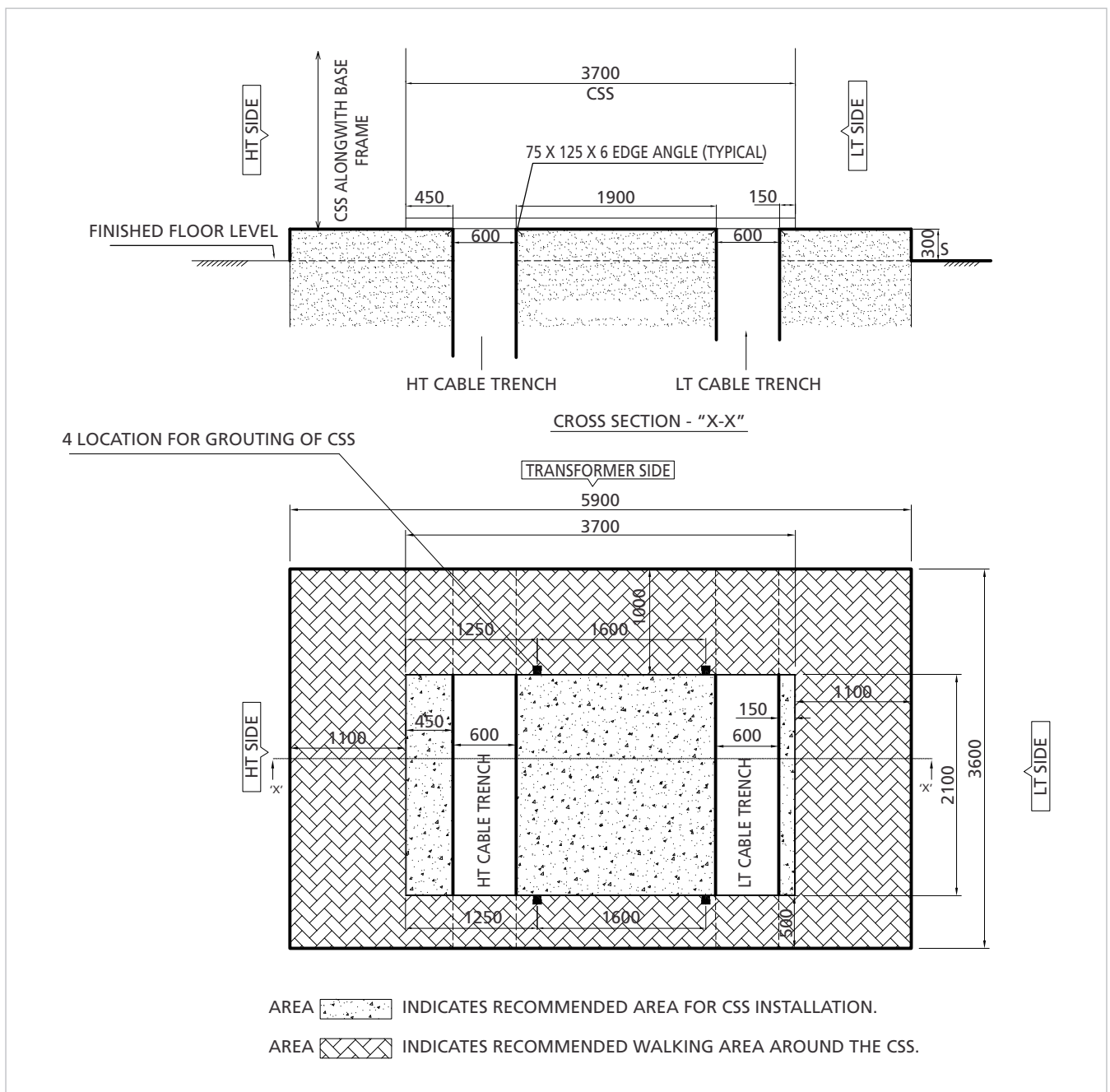

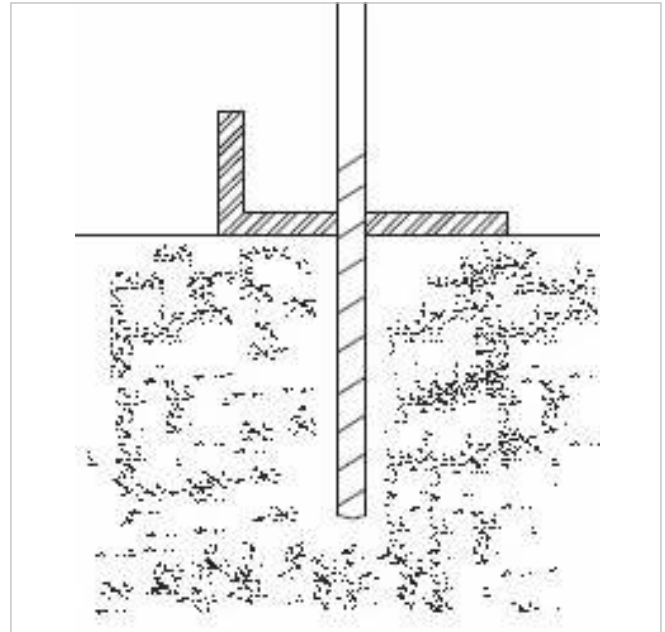


Figure 5.4 - Typical Foundation Plan Of CSS

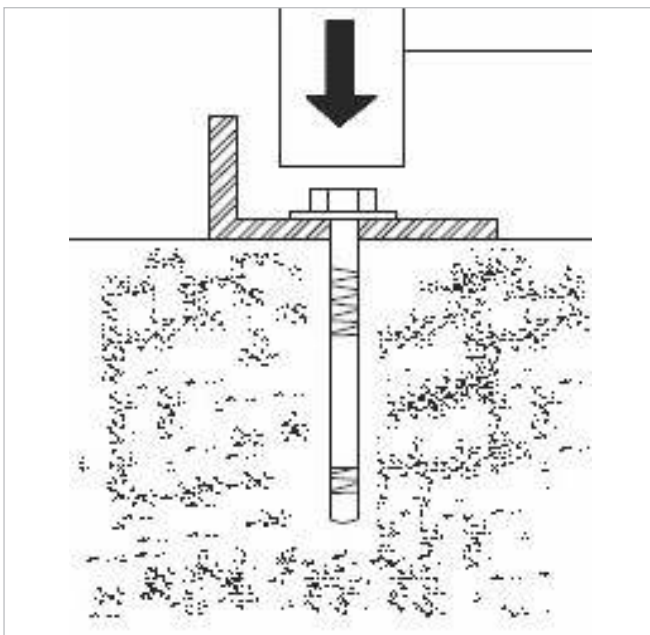
5.4.1 BASE FOUNDATION

IT IS IMPORTANT that the unit is level and vertical when erected in position. Adjustments can be made by using steel packing plates under the corners of the base framework. The floor tolerance for extensible switchboards is $\pm 1\text{mm}$ over 1 metre. Where it is not possible to guarantee that the floor is within the specified tolerance, we strongly recommend the use of foundation channels. After positioning the unit use holes in base angles as template for drilling holes in concrete suitable for foundation bolts. Refer to Figure 5.4 for full details of drilling and fitting of foundation bolts.

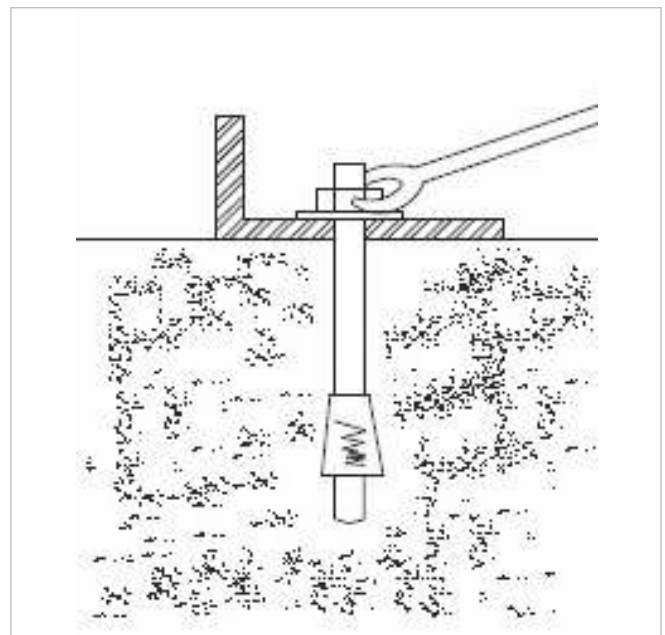
 **CAUTION** - Before making primary source connections, verify that the primary cables are de-energized and the equipment is properly grounded.



Step 1:
Drill hole on the floor as per required size



Step 2:
Insert the expansion anchor bolt into the drilled hole



Step 3:
Tighten out the nut as per specified torque

Figure 5.4.1 - Method of fitting foundation bolt

5.5 GENERAL INSTRUCTIONS FOR INSTALLATION

- N-Qube is factory assembled and ready for installation on the concrete foundation provided at site.
- The internal connections are done in factory and only the network cables are to be connected at site.
- N-Qube is transported with Distribution Transformer factory fitted inside the transformer compartment. Hence removal and refitting of CSS roof is not required on site enabling easy installation.

5.5.1 MV SWITCHGEAR CONNECTION

To carry out the connections between incoming cables and HT Switchgear:

- Roll in the cables through preformed trench and connect it to the HT switchgear terminals with suitable cable terminations and proper glanding at the bottom plate.
- Protective screen of the cable is to be earthed to HT switchgear earthing.
- Ensure proper tightness of connections.

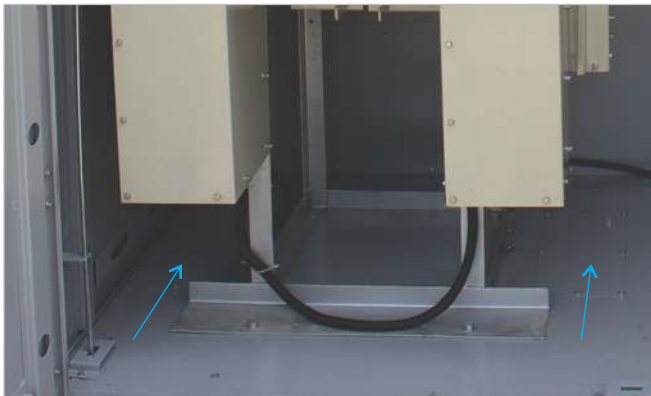


Figure 5.5.1 - HT cable gland location at RMU

5.5.2 LV SWITCHGEAR CONNECTION

To carry out the connections between incoming cables and HT Switchgear:

- Roll in the cables through preformed trench and connect it to the LT switchgear terminals with suitable cable lugs and proper glanding at the bottom plate.
- Protective screen of the cable is to be earthed to LT switchgear earthing.

- Ensure proper tightness of connections.

5.5.3 INSTALLATION OF TRANSFORMER

- N-Qube is dispatched with pre-installed distribution transformer.
- The HT cables are to be mounted on transformer terminals, the cables are fixed to the inside wall of the substation by means of pre-mounted cable fixing clamps.
- If LT switchgear is connected by cables, these (the cables) are mechanically locked together by means of fixing clamps and brackets and are not to be fixed to the wall of the substation.
- In case the LT Switchgear and the transformer are connected by busbar, the connections are made by flexible connectors.

5.5.4 EARTHING

- The earthing conductors from earthing pits are to be connected to the HT switchgearbody, LT switchgear body, transformer body and transformer neutral respectively in line with earthing connection diagram.
- Galvanised iron earthing conductors of size 50 X 6mm are provided.
- Inter connection between HT switchgear and transformer uses single core cable. The cable screen is to be earthed only on the HT switchgear side.

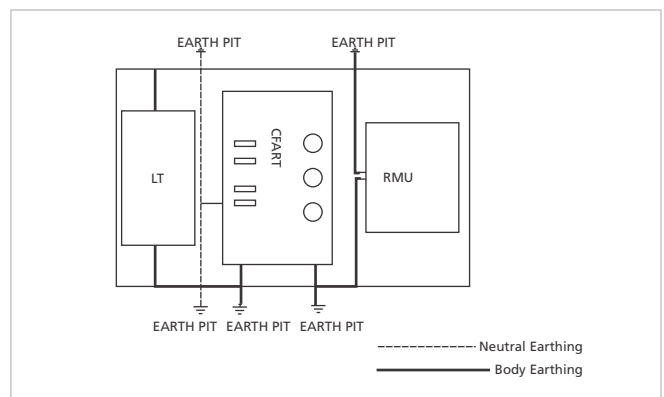


Figure 5.5.4 - Earthing Location Diagram

5.6 Electrical tests before cabling or connection to transformer

All switches must be in the 'ON' position, and the following tests taken through any one set of cable terminals.

Measure the insulation resistance to earth of each of the three terminals in turn, with the other two earthed. The readings

should not be less than 200 mega-ohms. Lower values may indicate damaged or dirty insulation.



CAUTION - Should the readings be less than 200 megaohms the following high voltage test should not be undertaken.

The high voltage test should be made in the same manner as the megger tests and in accordance with following table

Table 5.1: HV test conditions for RMV

Test Condition No.	Ring Switch (1)	Ring Switch (2)	CIRCUIT BREAKER	POWER FREQUENCY WITHSTAND VOLTAGE (As per below chart)	EARTH
1	CLOSE	CLOSE	CLOSE	RB	Y
2	CLOSE	CLOSE	CLOSE	Y	RB
3	OPEN	OPEN	CLOSE	RYB	R ₁ Y ₁ B ₁ R ₂ Y ₂ B ₂
4	CLOSE	CLOSE	OPEN	R ₁ Y ₁ B ₁	RYB R ₁ Y ₁ B ₁

NOTE: The test voltages given are for alternating current (A C) with a frequency of 25 to 100 cycles.

Rated Voltage (kV AC)	Power Frequency withstand Voltage (kV)*
3.6	10
7.2	20
12.0	28

Rated insulation level at rated voltage (As per IEC-60694)

*Note: The power Frequency withstand voltage at site shall be 80% of the values as indicated as per above table.

6.0 COMMISSIONING

This section is a guide to the minimum checks and tests that should be performed on site prior to energising the equipment.

6.1 PRELIMINARY CHECKS

Preliminary inspections should be carried out prior to the connection of the high voltage supply:

1. Check the mechanical and electrical interlocks for correct operation.
2. Check that the RMU is earthed to the station earthing.
3. Check the gas monitors for correct operating pressure within the green zone.
4. Check that the control power is on.
5. Perform a dielectric test on the power cables as per Standards.
6. Conduct an operational test on RMU's and LT panel control and protection system.
7. Check the general condition of the substation for any abnormalities that will affect operations.
8. Check external equipment such as remote controls, auxiliary power source if any condition.
9. Perform phase sequence test.

6.2 START-UP

1. During start-up, safety regulations should be observed.
2. Ensure that all the switch disconnectors and circuit breakers are in off position.
3. Remove any connecting or shorting links used during the preliminary tests.
4. Energise the HT & LT panels step-by-step, observing all signals and indicators.
5. Check the phasing of the incomers.
6. Watch out for any visible abnormalities/anomalies.

6.3 ELECTRICAL TESTS AFTER CABLING OF CONNECTION TO TRANSFORMER

Operate one ring feeder switch to the 'EARTH-ON' position then operate the interlock and open the test connection box. Apply a test voltage of 36kV dc between phases with the mid-point earthed, and 25kV dc to earth for 15 minutes. Repeat tests on the other ring feeder switch. Operate the transformer earth switch to the 'EARTH-ON' position then operate the interlock and open the test connection box (see section x). Apply a test voltage of 36kV dc

6.4 CABLE TERMINATION


The cable selection for termination can be done by the following

Cable Type	Operating Voltage upto 12kV
Heat shrink cable	YES
Reusable insulating shrouds	YES
Touch-proof cable	YES

Table 6.4: Cable options

When using heat shrinkable cable termination and coupling joint insulation kits, the fitting instructions supplied with the kit must be adhered to. The sleeving included in the kit must overlap the cable box bushing by at least 50mm on each phase. The overlap section of the bushing must be thoroughly cleaned preferably by the use of an abrasive material to remove any silicone release agent on the surface of the bushing. This is to ensure water tight sealing when the heat shrink termination is completed. Care must also be exercised to ensure that local overheating of any insulation does not occur.

Palm type sockets can be bolted on to the bushing conductors and the bolt tightening torque should not exceed the values given in Figure 6.2.

 **CAUTION** - Cable bushing terminations in Sf6 compact switchgear that are not in use are to be isolated with a protective shroud (accessory).

Note: The 3mm thick Copper washers provided must be fitted between the socket palms and the bushing conductor ends (Refer Figure 6.1), to ensure an adequate contact area.

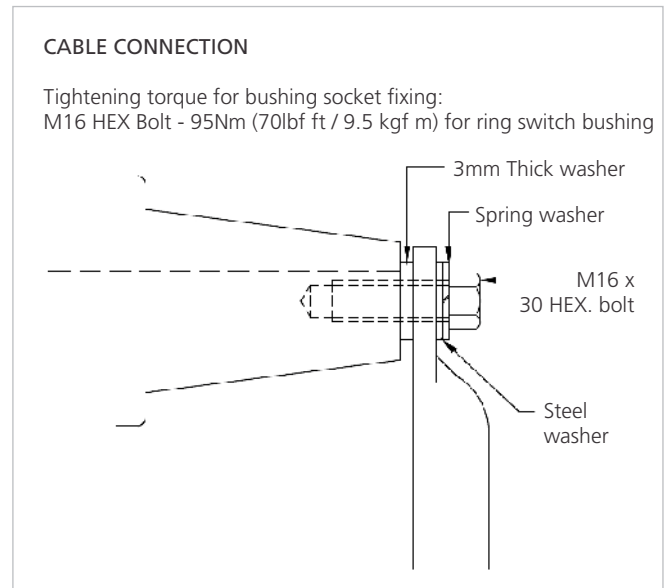


Figure 6.4.1 - Cable connection

For reusable insulating shrouds and touch-proof type connection please refer the respective vendor's manual.

For compact version of RMU Tee-Off bushing is in downward direction. To facilitate the termination the bushings are provided with L-type adapter for ease of termination (Refer Figure 6.4.2).

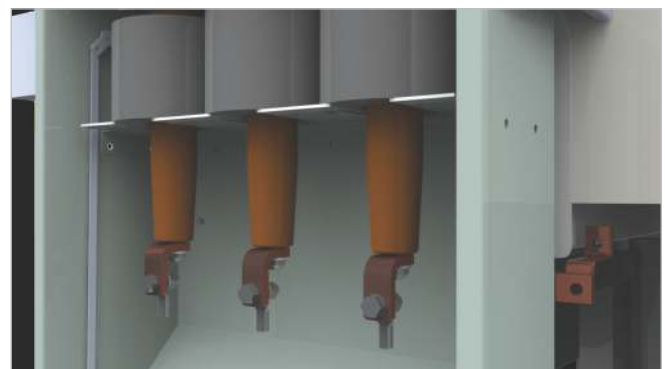


Figure 6.4.2 - Tee-Off Bushing arrangement with L-bracket adapter for cable termination



Figure 6.4.3 - LT Panel Cable Termination

6.5 CONNECTING THE EARTH

Grounding (Earthing) recommendations as per IEC 61364-1 and the US body National Electrical Code stipulated a solid grounding without any intentional impedance to achieve the lowest ground resistance value possible. Typically a ground resistance value of 5 ohm or less is recommended for the substation earth but some utilities construct their ground systems so that the resistance at a substation will be no more than a few tenths of 1 ohm.

For location of earthing point in GR1VI series of RMU please refer Figure 5.5.4.



CAUTION - Earthing (grounding) bus connections should not penetrate any part of the CSS not intended for cable entrance. Not following this practice will affect the arc-resistant performance of the switchgear.



CAUTION - Before making primary source connections, verify that the primary cables are de-energized and the equipment is properly earthed (grounded).

6.6 INSPECTION AFTER INSTALLATION

1. Check that the doors can be smoothly opened and closed.
2. Make sure that the bolts and nuts that were tightened during installation are not loose.
3. Factory-tightened bolts and nuts are torque-marked with a black paint. Check that the marks on these fastenings are not shifted.
4. Check that the earthing bars are correctly connected and that the earth is connected at one point to the substation earthing.
5. Inspect all protection relays and meters. Remove shipping stops, if any.
6. Make sure all mechanical and electrical interlocks are well in place.
7. Clearance distances, cable termination, busbar connections and arrangement according to the main circuit diagram are to be visually inspected.
8. If this is a measuring cubicle check that the instrument transfer ratios are correct.

- All switchgear and component mechanical functions are to be checked by operating them twice.
- Make sure all mechanical and electrical interlocks are well in place.
- Clearance distances, cable terminations, busbar connections and arrangement according to the main circuit diagram are to be visually inspected.
- If there is a measuring cubicle check that the instrument transformer ratios are correct.
- Check that all necessary warning labels are fitted on the substation.
- Perform the inspection procedures detailed in the installation and operation manual for MV switchgear.
- Carry out the inspection procedures required by the respective authorities. Before connecting the MV switchgear to the network, check the status of the network, the switchgear and the earthing switches.

7.0 OPERATING PROCEDURE

Components used in the CSS such as HT Switchgear, LT switchgear, and transformer all have separate operating and maintenance instruction manuals. Operating procedures are to be performed in accordance with these instructions.

7.1 OPERATING INSTRUCTION FOR

E&A Make GR1 VI Type RMU and LVDB have inbuilt standard interlocks required for safety of personnel and equipment as per latest IEC standards

TYPE GR1-VI-21

12kV 21kA 630A RMU

CSS is provided with following additional interlocks:

- RMU to trip if the door of transformer compartment is open.
- Inhibit closing operation of RMU if transformer compartment door is open.
- Lamp to glow in MV, LV and transformer compartment when their respective doors are opened.
- For Oil type Transformer, OTI trip contact to be used to trip RMU.

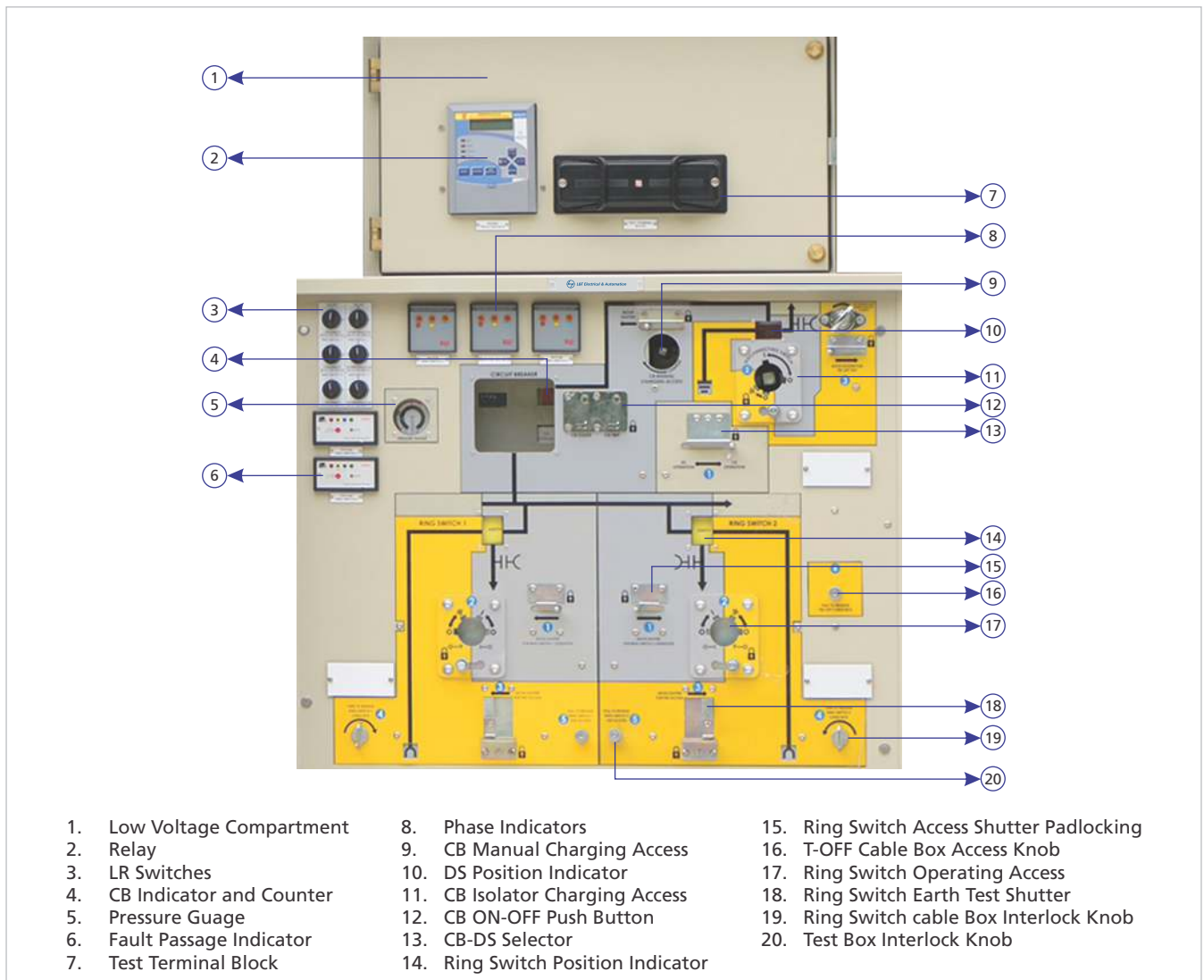


Figure 7.1.1 - Operating facia of typical 2+1 configuration RMU



Figure 7.1.2 -

OPERATING INSTRUCTIONS FOR RING SWITCH 1 & 2

- I. SLIDE SHUTTER MARKED AS 1 TO INITIATE RING SWITCH OPERATIONS.
- II. PULL AND SLIDE THE KNOB MARKED AT 2 TO THE DESIRED OPERATIONAL POSITION AND RELEASE.
- III. INSERT HANDLE IN THE APPROPRIATE SLOT MARKED AT 2 AND ROTATE IN THE DESIRED DIRECTION AND REMOVE THE HANDLE.
- IV. SLIDE THE SHUTTER MARKED AS 1 TO ITS INITIAL POSITION.
- V. TO ACCESS CABLE:
 - a) ENSURE RING SWITCH IS IN EARTH POSITION.
 - b) SLIDE SHUTTER MARKED AS 3 IN AS INDICATED.
 - c) TO OPEN CABLE BOX ROTATE THE KNOB MARKED AS 4 IN THE INDICATED DIRECTION. (BY 90 DEG)
 - d) TO OPEN THE TEST BOX PULL THE KNOB MARKED AS 5.

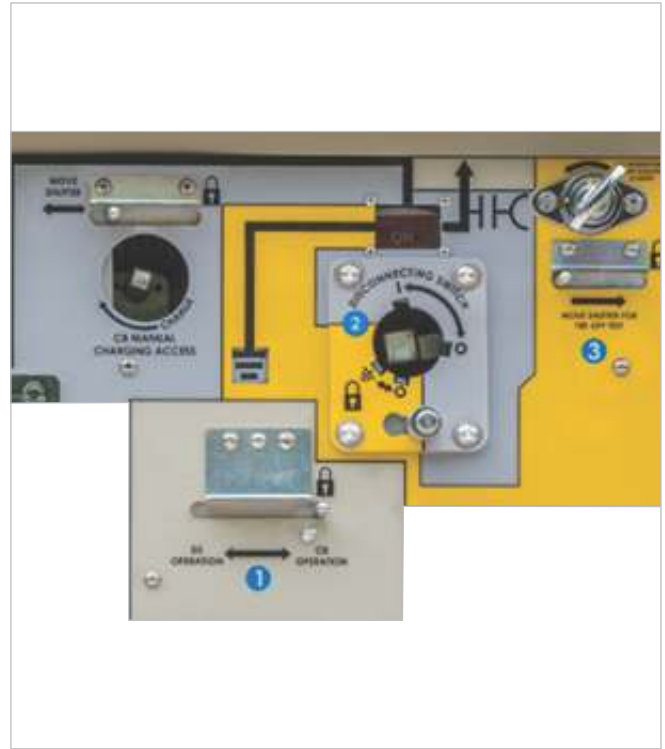


Figure 7.1.3 -

OPERATING INSTRUCTIONS FOR CB DISCONNECTING SWITCH (DS)

- I. ENSURE CIRCUIT BREAKER IS IN OPEN CONDITION.
- II. SLIDE THE KNOB MARKED AS 1 FOR DS OPERATION AS INDICATED.
- III. PULL AND SLIDE THE KNOB MARKED AS 2 TO THE DESIRED OPERATIONAL POSITION AND RELEASE.
- IV. INSERT HANDLE IN THE APPROPRIATE SLOT MARKED AS 2 AND ROTATE IN THE DESIRED DIRECTION AND REMOVE THE HANDLE.
- V. TO ACCESS T-OFF CABLE BOX:
 - a) ENSURE ISOLATOR IS IN EARTH POSITION.
 - b) SLIDE SHUTTER MARKED AS 3 IN THE DIRECTION INDICATED.
 - c) TO OPEN CABLE BOX PULL THE KNOB MARKED AS 4.

1. Follow These Instructions Independently for Each Ring Switch.
 2. When RMU is 2+2(4 Way), Follow These Instructions Independently for Each Disconnecting Switch.

8.0 MAINTENANCE AND INSPECTION

A regularly scheduled electrical system preventive maintenance program is intended to detect, repair, or replace affected electrical components, parts, or equipment before they lead to catastrophic damages, significant power interruptions, and loss of business functions.

Substation should be cleaned, inspected, tightened, lubricated, and exercised on a regular basis. The frequency of maintenance depends on the environment, the condition of the equipment, and its criticality.

Moisture and heat combined with dirt, dust, or other contaminants in the environment will deteriorate the insulation, conductive materials, and protective devices in the equipment at an accelerated rate. These factors should be considered in determining whether maintenance should be performed annually, every 3 years, or somewhere in between. An expert in the maintenance of switchgear can assist in preparing a maintenance plan for each line-up of switchgear.

A thorough on-site maintenance work scope for CSS

- Visual Inspection of the switchgear
- Cleaning and lubricating.
- Insulation verification, testing and inspection for integrity especially insulation devices at joints typically boots, end caps etc. Replace boots and end caps that are showing signs of aging or cracks.
- Cleaning of the copper contact of earthing point
- Charge/close/trip circuit testing and verification including functionality of the protection circuit function.
- Check and confirm correct operation protective scheme and devices (update with new technology where necessary)
- Adjustments and fixing as deemed appropriate

Important Note:

1 -Correct operation of switchgear especially timeous vacuum circuit breaker operation (tripping) is not only dependent on regular maintenance but more importantly dependent on the trip signal received from the protection devices (relays). Therefore correct protection operation is paramount for the switchgear to operate according to the intended circuit protection and switching logic, especially to clear a fault condition.

2 -RMU is designed to be maintenance-free, requiring only generic cleaning and inspection. To keep the desired level of performance of the installed devices, enable early detection of faulty parts and thereby forestall possible troubles, it is

recommended that the following check is performed according to IEC 1208:

- Inspection:** to predict actual condition
- Servicing:** to preserve specified conditions
- Repairs:** to re-establish specified conditions

Maintenance servicing may only be performed by trained specialists familiar with the particular characteristics of the switchgear. It is recommended that E&A service engineers be called in to carry out critical critical maintenance or repair works.

8.1 FUNDAMENTAL PHILOSOPHY OF MAINTENANCE AND INSPECTION

- The gas-sealed sections are continually monitored by the gas monitoring device so it does not require a periodical overhaul and inspection.
- It is recommended that an ordinary inspection centering on operations. Check be performed one year after installation and there after once every 2-4 years depending on operating and local conditions.
- It is recommended that operation mechanisms for circuit breakers and other devices be subjected to a detailed inspection once every 6 years.
- When any abnormal condition(s) are detected or when a specified number of operation is reached, an inspection should be performed.

8.2 CLASSIFICATION OF MAINTENANCE AND INSPECTION

1) Routine Inspection

This inspection is performed externally while the panel is in operation such as voltage and current readings and any deviation from normal conditions. This inspection is part of the routine patrol on the facility as a whole.

2) Periodical Inspection (Ordinary and Detailed)

This inspection is performed periodically at specified intervals to keep the RMU and installed devices in good condition and at the required level of performance.

- Ordinary inspection:

RMU operation is not interrupted and check is made mainly external such as the effects of pollution or any other environmental influences.

- Detailed inspection:

RMU operation is interrupted and checked for protection and control functions and operations of signalling devices and interlock mechanisms. Parts replacement is done according to criteria.

- When 1000 operations are reached

Basic work on the panels should include but not limited to the following:

General cleaning of panels: Clean off all contamination and condensation when panels are installed in the tropics. Remove any dust or dirt deposits, which can be lightly swept off with a lint free cloth. Remove any sticky and greasy deposits on insulators with a lint-free cloth dipped with an approved cleaning agent.

3) Servicing

Servicing is performed in the following cases:

- When an abnormal condition is found as a result of inspection and

8.3 CONTENTS OF INSPECTION

Check points for visual, ordinary and detailed inspections are listed in table below:

Category	Check point		Inspection		
			Visual	Ordinary	Detailed
Operation Mechanism	Visual check	Loose bolts and unts			
		Dust and foreign matters			
		Dislocated parts			
		Filling and Chips	✓	✓	✓
		Indication of indicator and Counter			
		Deformation, damage, wear			
	Operation	Resetting operation of trip prop and closing prop			
		Movement of rollers and pins		✓	✓
		Warping or galling of parts			
		Check on reset condition			
Greasing	Remove old grease and apply new grease			✓	
Control Circuit	Visual check	Check for dislocated connectors and pins and for deformation and break		✓	✓
		Check for loose fastenings of the switch terminals and for rust			
	Check on mechanical parts	Operation of auxiliary switches		✓	✓
		Contact state of limit switches			
		Electrical open-close operation			
Vacuum Interrupter	Check on wipe dimension (Must be larger than 1mm)			✓	✓
	Number of open-close operation (Replace the interrupter when 10,000 operations are exceeded)		✓	✓	✓
Others	Whole circuit breaker	Abnormal noise		✓	✓
		Abnormal smell			

9.0 DO'S AND DON'TS

Read Operation & Maintenance Manual carefully before doing any Operation on the RMU.

DO's

- Operate the RMU only when the needle of RMU is in green zone
- Ensure proper Earthing of RMU.
- Ensure proper setting of Relay and Fault Passage Indicator.
- Always check the Capacitive Voltage Indicator before any operation.
Indicator ON: Line voltage present
Indicator OFF: Line voltage absent
- Before opening cable compartment cover, ensure that the feeder is Earthed.
- Ensure that cable boots are mounted on cable bushing according to Installation & operating instruction.
- Always check whether the cable boot is properly mounted and inserted on the bushing with end caps.
- The Cable must be properly clamped or supported before connecting it on the bushing.

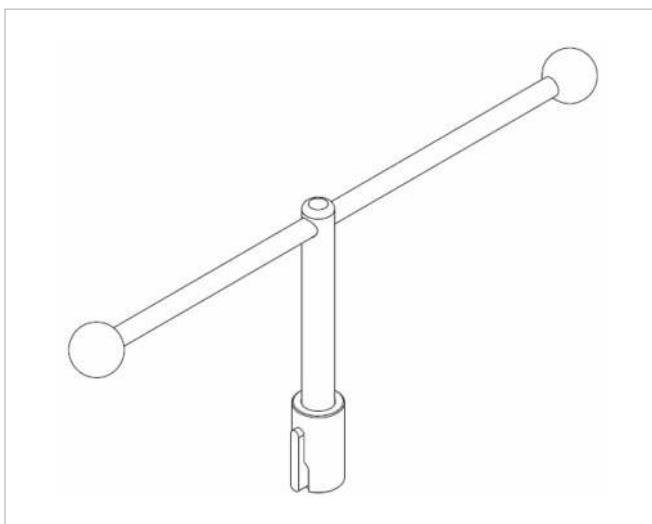
DON'Ts

- Do not apply any flammable lubrication on the busbar joints or VCB finger contacts.
- Bushing and cable should not be left open
- Over or under sized nut & bolt should not be used at any new cable termination
- Do not charge the RMU without Insulating End Plug's and Dead End Cover on Busbar bushing (Extensible RMU only).
- Earthing should not be done when voltage indicators are glowing
- The bushing and hole of lug should not be stuffed together forcefully
- Without support the cable should not be connected with the bushing
- The cable should not be half inclined otherwise it may damage the bushing
- Bolts and washers should not be left loose

NOTE : For transformer & LV Operation & Maintenance - please refer Do's & Don'ts in their respective ONM Manual.

10.0 STANDARD ACCESSORIES

MANUAL VCB CHARGING & DS, RSW OPERATING HANDLE



11.0 MANDATORY SPARES

1. Charging handle
2. Closing Coil
3. Tripping Coil
4. TLF (If provided in RMU)

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