

**MANUAL for SAFETY  
(Jan 2015)**

**RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LIMITED**

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## CHAPTER -1

### POLICY, PHILOSOPHY, PRINCIPLES AND AUDIT

#### 1.1 POLICY

- i) The RVPN Safety Rules & Safety Instructions are drawn up to comply with the requirement of the Indian Electricity Rules, 1956.
- ii) The RVPN recognizes and accepts its statutory and moral responsibilities for ensuring safe design, construction, operation and maintenance of equipment and for the provision of safe methods of work and healthy working conditions. These requirements rank equally with other objectives of the Company.
- iii) The success of the Policy relies on all employees complying with safety requirements relevant to their responsibilities.

#### 1.2 PHILOSOPHY

- i) Transmission of electrical power at Extra High and High Voltage is carried out using the electrical and mechanical items of equipment, interconnected to form electro-mechanical systems. These systems contain inherent dangers but are designed so that they are safe when operated normally.
- ii) When work or testing is to be carried out on or near to these systems, rules need to be specified to achieve safety from the inherent danger.
- iii) These Safety Rules are based on a philosophy that persons will be protected from the inherent dangers. This is achieved by making persons “safe from the system”.
- iv) The inherent dangers are those arising from a system. The RVPN Safety Rules and Safety Instructions define the procedures and responsibilities for achieving safety of persons from inherent dangers.
- v) The Safety Rules are supplemented by the RVPN Safety Instructions which define the actions to be taken to apply the provisions of the Safety Rules.
- vi) The Safety Rules and Safety Instructions together form a system to provide a safe procedure for work or testing on the system and can be summarized as follows:
  - a) Making available the equipment concerned for the maintenance work or testing work.
  - b) Establishing safe conditions for maintenance work or testing work. This can be achieved by either limiting the area of work or testing or by isolating and discharging the contents to a safe working level.
  - c) Authorizing the maintenance work or testing to commence.
  - d) Receiving the authority to carry out maintenance work or testing, carrying out the work or testing while maintaining those safe conditions.
  - e) Cancelling the authority to work or test on completion of the work or testing
  - f) Restoring the system to normal.

- vii) Further dangers are those arising from the environment in which persons undertake work. The way in which these dangers are managed is specified in the Safety Rules and Safety Instructions.

### 1.3 PRINCIPLES

The principles supporting the Policy and Philosophy for the Safety Rules and Safety Instructions are as follows:-

- i) The Safety Rules and Safety Instructions are only designed to protect people.
- ii) The primary method of achieving safety from the system is by isolation, followed by earthing for EHV and HV equipment. In the case of mechanical equipment, this shall be followed by draining, venting, purging and discharging stored energy systems (as appropriate). Where reasonably practicable, all points of isolation, vents and earths should be locked.
- iii) The application of specific instructions / procedures where these Rules cannot be applied (e.g., Live / Hot Line Working).
- iv) The safety precautions for all work and testing shall be maintained across all internal and external control boundaries.
- v) Training of all staff and monitoring / authorizing certain staff that will carry out specific duties in the application of the Rules.
- vi) Ensuring compliance by a regular and systematic audit.

### 1.4 SAFETY AUDIT

**It is essential that safety standards are maintained at all times and although all staff must comply fully with the Rules, a regular check will assist in maintaining the highest possible level of safety.**

**This audit process must not be seen as an investigation into a person's performance, but rather as an aid to implementing, maintaining and improving high levels of safety. The provisions related to Safety Consultant and Safety Audit are mentioned in Schedule L of Draft Transmission Agreement**

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## CHAPTER -2

### DEFINITIONS

Additional Earth(s):	Temporary, portable <b>Earth(s)</b> which are issued to the recipient of the Permit to Work or Permit to Test and are included in an Earthing Schedule. They are applied within an <b>Isolated Zone</b> in order to discharge any induced voltage. Additional Earth(s) shall be minimum 35 sq. mm copper equivalent.
Approved Procedure:	RVPN Safety Instructions or other specialized procedures <b>approved</b> by CE / SE/Safety Consultant.
Authority:	shall have the meaning attributed thereto in the array of Parties as set forth in the Recitals in the Transmission Agreement;
Authorized Person:	Maintenance / Testing Engineer. <b>Maintenance Engineer:</b> Responsible for carrying out maintenance works of EHV & HV equipments, transmission lines & LT systems. <b>Testing Engineer:</b> Responsible for carrying out testing of protective systems, PLCC panels and other related equipments.
Caution Notice:	A notice in prescribed form to be <b>placed at all points of isolation</b> , or attached to all vents and drains and to <b>Primary Earths</b> where practicable and to control and operating devices to indicate that work or testing is being carried out.
Certificate of No Back Feed:	A certificate which records the details of <b>Isolation</b> carried out at a remote substation in order to achieve <b>safety from EHV/HV</b> systems and from test supplies.
Certificate of Earthing	A certificate which records the details of <b>Isolation &amp; earthing</b> carried out at a remote substation in order to achieve <b>safety from EHV / HV</b> systems and from test supplies.
Company:	RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LTD. (RRVPNL, or, in short, RVPN).
Competent Person:	A person not below the level of Supervisor or Technician.
Concessionaire:	shall have the meaning attributed thereto in the array of Parties as set forth in the Recitals in the Transmission Agreement;
Danger:	A risk to health, or of bodily injury, or to life.
Danger Notice:	An approved notice reading <b>“Danger” in Hindi and English with a sign of skull &amp; bones.</b>
Dead:	Not electrically Live or Charged.
Earthing Device:	An approved means of providing a connection between an electrical conductor / equipment and earth, being either a “Primary Earth” or an “Additional Earth”.

Earthing Schedule:	A schedule indicating the requirements of Additional Earth(s) for each stage of the work or testing. It must show the number of earths required and either describe or show pictorially their position in the Isolated Zone.
Equipment:	Electrical and mechanical apparatus / equipment used to protect, control, measure, generate, transmit and distribute electricity to which the Safety Rules apply.
Extra High Voltage (EHV):	Any voltage in excess of 33,000 volts (AC/DC).
General Safety:	Those actions required to maintain a safe environment / place for work / testing, e.g., safe access and safe methods of work & testing and the correct use of personal protective equipment.
High Voltage (HV):	A voltage between 650 volts and 33,000 volts.
Isolated:	Disconnected from associated Equipment by Isolating Device(s) in the isolated position, or by adequate physical separation.
Isolating Device:	A device for rendering Equipment Isolated.
Isolated Zone:	<b>All items of equipment contained within a work / testing area for which isolation has been achieved at all points of supply.</b>
Keys(Safety Key):	The key from a unique lock (at a location) which is used for locking / interlocking an Isolating Device, Earth or Drain / Vents.
Key Safe:	A designated lockable cabinet for the safe custody of all Safety Keys.
Live:	Charged / Energized at a voltage by being connected to a source of electricity.
Lock / Locks:	A device used for immobilization of an item of Equipment.
Lock Closed:	To secure an item of Equipment with padlocks or other device such that it is immobilized in the closed position.
Lock Open:	To secure an item of Equipment with padlocks or other device such that it is immobilized in the open position.
Low Voltage (LV):	A voltage not exceeding 250 volts.
Medium Voltage (MV):	A voltage between 250 and 650 volts.
Northern Region Load Dispatch Center (N R L D C):-	The center where the operations of Northern <b>Regional</b> Electricity grid constituting the power systems of the <b>constituents of Northern Region</b> are monitored & coordinated.
Point(s) of Isolation:	The point(s) at which Equipment has been Isolated and, when practicable, the Isolation Point <b>must remain</b> immobilized and Locked.  <b>Caution Notices shall be attached to all Points of Isolation.</b>

Primary Earth(s):	<b>Earth(s)</b> {Either fixed earth Switch(es) or Portable Earth(s) with sufficient / suitable electrical capacity} applied between the point of work and all points of <b>EHV / HV isolation</b> before the Permit To Work or Permit To Test is issued. <u>Primary earth(s) shall be minimum 95 sq. mm copper equivalent.</u>
Permits To Test (PTT):	A safety Document specifying the EHV / HV Equipment and the testing to be carried out and the actions taken <b>to avert / avoid</b> the disturbance of the system during the testing.
Permits To Work (PTW):	A Safety Document specifying the Equipment / Area and the work / testing to be carried out and the actions taken to achieve Safety from the system.
Purged:	A condition of Equipment from which any dangerous contents have been removed.
RSI:	RRVPNL Safety Instructions.
Safe Electrical Clearance:	A <b>minimum</b> distance of 1.5 meters which must be maintained by lineman / <b>workman</b> from the conductors or jumpers of a de-energized overhead line which has been Isolated & Primary earthed and for which a Safety Document has been issued before connection of Additional Earths under the terms of that Safety Document.
Safety Document:	A Document specifying the Equipment / Area and the work / testing to be carried out and the actions taken to achieve Safety from the system (Permit To Work), or to safeguard the disturbance of the system during the testing (Permit To Test).
Safety from the System:	That condition which safeguards persons working on or near to Equipment from the Dangers which are inherent in a System.
Safety Working Clearance:	The minimum clearance to be maintained in air between the live part of the equipment on one hand and earth or another piece of equipment or conductor on which it is necessary to carry out the work, on the other.
Senior Authorized Person / Shift In charge:	Engineer responsible for all operations and activities in substations.
State Load Despatch Centre (SLDC):	The <b>RVPN's</b> control room is at Heerapura (Jaipur) for operation round the clock for the purpose of managing the operation of the State Transmission System and co-ordination of <b>State</b> generation and Drawal on a real time basis.
Supervision:	Supervision, Personal / direct, by an Authorized Person who is available at the point of work or testing at all times during the course of that work or testing.
System:	Items of Equipment which are used either separately or in combination to generate transmit or distribute electricity.
Vented:	Allowing a closed space to have an outlet to atmosphere so that the pressure has equalized to atmospheric.

## **CHAPTER -3**

### **GENERAL PROVISIONS**

#### **3.1 GENERAL SAFETY.**

- i) In addition to the requirements for establishing Safety from the System specified in these Safety Rules and Safety Instructions, General Safety shall be established and maintained at all times.
- ii) General Safety shall be established by the person holding the Safety Document before work / testing starts. The person responsible for establishing General Safety shall be specified in the Safety Instructions.
- iii) During the course of work, the person in charge of the work / testing shall ensure that each & every member of the working party maintains General Safety.
- iv) It is the responsibility of all members of the working party, overseen by the person in charge of the work / testing, to ensure that their activities do not affect other work areas.

#### **3.2 SAFETY RULES, SAFETY INSTRUCTIONS AND PROCEDURES.**

- i) These Safety Rules, Safety Instructions and Procedures are mandatory.
- ii) Relevant Safety Rules issued by other Authorities should also be considered mandatory when designated as in Basic Safety Rules.

#### **3.3 SPECIAL INSTRUCTIONS.**

Maintenance Work or testing carried out on or near to a System to which these Safety Rules cannot be applied, or for special reasons should not be applied, shall be carried out in accordance with an Approved Procedure. (e.g., EHV / HV Live Line / Hot Line working which cannot be covered in these Safety Rules).

#### **3.4 OBJECTIONS ON SAFETY GROUNDS.**

Any person who has objections on safety grounds in the application of these Safety Rules and Safety Instructions shall explain their reasons to the person holding the Safety Document. If their objections cannot be resolved immediately, then the matter should be referred to the Shift - In - Charge. If the objections are still not resolved then the matter should be referred to the Sub Station - In - Charge/ Safety Consultant.



## CHAPTER -4

### THE BASIC SAFETY RULES.

#### 4.1 APPLICATION OF RULES.

- i) The Rajasthan Rajya Vidyut Prasaran Nigam Limited Safety Rules and Safety Instructions shall be applied when working on or near to items of Equipment which are part of a System described in .4.1(ii).
- ii) The System to which these Safety Rules and Safety Instructions apply is all those items of Equipment owned by RVPN Limited/ Concessionaire in case of PPP Projects and located within the Company's / Concessionaire's Sub Station fences or on its transmission lines.
- iii) Equipment shall be added to and removed from a system only in accordance with an Approved Handing over / Taking over Procedure. The same procedure will determine when the Safety Rules and Safety Instructions shall apply, or cease to apply.
- iv) Equipment located on another company's premises and on which RVPN/ Concessionaire personnel work, may be subject to RVPN Safety Rules and Safety Instructions, or to the owning Authority Safety Rules and Safety Instructions.

#### 4.2 APPROACH TO EXPOSED EXTRA HIGH VOLTAGE AND HIGH VOLTAGE CONDUCTORS AND INSULATORS.

- i) Persons shall not allow any part of their body or objects / tools & plant to approach within the specified Safety Clearance to exposed EHV / HV conductors which are Live. The only exception to this is during Live / Hot line work carried out on EHV / HV equipment in accordance with Approved specialized procedure.
- ii) **SAFETY WORKING CLEARANCE.**

Highest system Voltage (kV)	Safety working Clearance (in meters)
12	2.6
36	2.8
72.5	3.1
145	3.7
245	4.3
420	6.4

- iii) When Points of Isolation have been established **but** exposed conductors could be subject to Extra High Voltage or High Voltage, the only object permitted to approach within Safety **Working** Clearance shall be Approved voltage measuring devices or Earthing Devices.
- iv) When Points of Isolation have been established by the application of Earthing Devices, approach is allowed under an appropriate Safety Document within the specified Safety Clearance.

#### 4.3 SAFETY PRECAUTIONS FOR WORK OR TESTING ON OR NEAR TO EXTRA HIGH VOLTAGE OR HIGH VOLTAGE EQUIPMENT.

- i) (a) When work or testing is to be carried out on or near to EHV / HV equipment, the means of achieving safety must be assessed according to Safety Instructions 01.

- (b) The EHV / HV equipment must be identified.
- ii) Safety Documents.
  - (a) When work or testing is to be done on the **normally energized part / primary side** of the EHV / HV equipment and it is necessary to provide Primary Earths, a **Permit To Work (PTW)** shall be issued. In case it is required to remove the Primary Earth for the purpose of testing (such as meggering), this shall be done after taking due precautions as required.
  - (b) When work or testing is to be done on the **normally not energized part / secondary side** of the EHV / HV equipment, such as for relay testing or CB operation testing or work on secondary side of CT's / PT's, and does not require the de – energization of the equipment or the providing of Primary Earths, **Permit To Test (PTT)** shall be issued.
  - (c) The Safety Document must show the Safety Precautions taken to achieve safety from the EHV / HV system and also further precautions required to protect persons from inherent dangers in other systems. (e.g., purging for the removal of substance injurious to health, venting, draining and removal of stored energy as quoted in safety rule .4.5(iii) and LV / MV supplies).
  - (d) Within any Isolated Zone, any number of PTWs may be issued after consideration of 4.3(ii)(g).
  - (e) Within any Isolated Zone, only one Permit To Test shall be in force at any time. PTWs may be permitted in the same Isolated Zone at the same time as the Permit To Test is in force **provided** the different scopes of work or testing do not pose any danger to the working personnel and the equipment(s). The recipients of the PTT and PTW shall concur and be informed of the status.
  - (f) When the restoration of motive power is required for work or testing, the supplies required must be stated on the Safety Document in accordance with Safety Instruction 01.
  - (g) If motive power supplies have been made available, no other PTWs shall be issued on the same equipment.
- iii) When Danger from induced voltages could arise during the course of work or testing, Additional Earths shall be applied.

#### 4.4 SAFETY PRECAUTIONS FOR WORK ON OR NEAR TO MEDIUM AND LOW VOLTAGE EQUIPMENT

- i) Where reasonably practical, work on or near to Medium and Low voltage equipment should be carried out with that equipment in Dead condition.
- ii) When work or testing is to be carried out on or near to MV / LV Equipment, then the means of achieving safety must be assessed according to Safety Instruction 04 and shall also comply with the following rules.
  - (a) The MV / LV Equipment shall be identified.
  - (b) The MV / LV Equipment shall be Isolated and those Points of Isolation secured.

- (c) The method of instructing how the work or testing is to take place can be either a Safety Document or Personal Supervision.
- iii) When it is unavoidable to carry out work or testing on MV / LV equipment which is not Dead, then suitable precautions to avoid Danger must be followed as detailed in Safety Instructions 04.

#### 4.5 SAFETY PRECAUTIONS FOR WORK OR TESTING ON OR NEAR TO MECHANICAL EQUIPMENT.

- i) When work or testing is to be carried out on or near to mechanical equipment, the means of achieving safety must be assessed according to Safety Instructions 01.
- ii) Safety Documents.
  - (a) **For work or testing with the Equipment Isolated and either non - operational or with limited restoration of motive power supplies, the Safety Document issued will be a Permit To Work.**
  - (b) **When testing of mechanical Equipment involves the application of test pressures, the Safety Document issued will be a Permit To Test.**
- iii) When the work or testing requires the issue of a Permit To Work according to Safety Rules .4.5(ii)(a), the precautions will be specified in the Permit To Work and must include the following:-
  - (a) The Mechanical equipment must be Isolated and Points of Isolation established for the work.
  - (b) Further precautions taken to protect persons from inherent dangers in mechanical systems. This must include draining, venting, purging and removal of stored energy.
  - (c) Venting emissions shall be dissipated so as to avoid Danger. Where reasonably practicable, vents shall be locked open and Caution Notices fixed.
  - (d) The removal of the stored energy must be carried out in a manner to contain or dissipate that stored energy safely.
  - (e) Where internal access is required and the residue of the contents could cause Danger, the mechanical equipment must be purged and that residue disposed of safely according to an Approved Procedure.
- iv) Where work or testing is to be carried out on mechanical Equipment and it is essential to restore motive power for that work or testing while the Permit To Work is in force, then the following additional precautions shall be applied.
  - (a) All supplies required must be stated on the Permit To Work in accordance with the Safety Instructions 01.
  - (b) If motive power supplies have been made available, no other PTWs shall be issued on the same Equipment.
- v) When the testing requires the issue of a Permit To Test according to Safety Rule .4.5 (ii) (b) then the procedures will be as described in Safety Instructions 01 and 10.

It is essential that the risks of testing are properly assessed by the Maintenance / Testing Engineer. This procedure should only be used when such testing is an operational necessity.

#### **4.6 OPERATION OF EQUIPMENT**

The operation of any Equipment to achieve Safety from the system shall never involve pre - arranged signals or the use of time intervals.

The operation of the equipment and / or its isolation and / or earthing shall be confirmed **before** the issue of Permit To Work or Permit To Test.

#### **4.7 DEMARCATION OF WORK AND TESTING AREAS.**

- i) The work and testing area shall be clearly demarcated.
- ii) Where necessary, physical protection must be provided to prevent Danger to persons in a demarcated area from adjacent System hazards.

#### **4.8 IDENTIFICATION OF EQUIPMENT**

Equipment shall be clearly marked with a unique code and / or description, which must be the information used on Safety Documents and in switching instructions.

**4. A**

RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LTD.  
\_\_\_\_\_KV Grid Sub Station, \_\_\_\_\_  
**PERMIT TO WORK**

In Person/On Telephone  
(In duplicate)

Permit No \_\_\_\_\_

Date \_\_\_\_\_

**A. REQUEST:**

1. Work Area:
2. Work to be done:
3. Period of PTW: (From)Date \_\_\_\_\_ (To) Date \_\_\_\_\_  
Time \_\_\_\_\_ Time \_\_\_\_\_
4. Details of isolation required:
5. PTW Requested by:  
Name:  
Designation:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**B. ISSUE of PTW**

1. Precautions taken to achieve Safety:  
i)  
ii)  
iii)
2. Work area is isolated / earthed and it is safe to work on. Additional earths may be provided at the place of work.
3. Further precautions to be taken to achieve Safety:  
i)  
ii)
4. "No Back Feed" / "Earthing" certificate No. \_\_\_\_ dt. \_\_\_\_ issued by \_\_\_\_\_ at (Time) \_\_\_\_\_.
5. PTW allowed: (From) Date \_\_\_\_\_ (To) Date \_\_\_\_\_  
Time \_\_\_\_\_ Time \_\_\_\_\_
6. Entry made in PTW register on page No. \_\_\_\_\_.
7. PTW Approved by:  
Name:  
Designation of Shift – In - Charge:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**C. RECEIPT:**

I hereby declare that I have inspected and have satisfied myself that such equipment where the work is to be carried out has been switched off and isolated / earthed. I also accept responsibility for carrying out work only on equipment detailed on this permit and that no attempt will be made by me or by any man under my control, to carry out work on any other equipment.

Name:  
Designation:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**D. RETURN OF PERMIT TO WORK:**

1. Details of work done:
2. Restrictions / changes, if any, on the equipment being returned to service:
3. CLEARANCE CERTIFICATE:  
I hereby declare that all men, material & earthing have been withdrawn and all personnel warned that it is no longer safe to work on the equipment specified in this permit and all tools and additional earths are clear and equipment is ready for charging.  
Name:  
Designation:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**E. CANCELLATION OF PERMIT TO WORK:**

1. PTW cancelled and entry made in PTW register on page No. \_\_\_\_\_.
2. SEQUENCE OF NORMALIZATION :  
i)  
ii)  
iii)  
Name:  
Designation of Shift – In – Charge:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

4 B

RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LTD.

(In duplicate)

\_\_\_\_\_KV Grid Sub Station, \_\_\_\_\_

PERMIT TO TEST

Permit No. \_\_\_\_\_

Date \_\_\_\_\_

**A. REQUEST:**

1. Test Area:
2. Testing to be carried out:
3. Period of PTT: (From) Date \_\_\_\_\_ (To) Date \_\_\_\_\_  
Time \_\_\_\_\_ Time \_\_\_\_\_
4. Details of isolation if required:
5. PTT Requested by:  
Name:  
Designation:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**B. ISSUE:**

1. Precaution(s) taken to safeguard the system:  
i)  
ii)
2. Further precautions to be taken to safeguard the system:
3. Test area is identified and it is safe to carry out test.
4. PTT allowed: (From) Date \_\_\_\_\_ (To) Date \_\_\_\_\_  
Time \_\_\_\_\_ Time \_\_\_\_\_
5. Entry made in PTT register on page No. \_\_\_\_\_.
6. PTT Approved by:

Name:  
Designation of Shift - In - Charge:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**C. RECEIPT:**

I hereby declare that I have personally inspected and have satisfied myself that such equipments where the test(s) are to be carried out has been switched off and isolated. I also accept responsibility of carrying out test(s) on equipment detailed on this PTT and that no attempt will be made by me or by any man under my control to carry out tests on any other equipment.

Name:  
Designation:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**D. RETURN OF PERMIT TO TEST:**

1. Details of tests carried out:
2. Restrictions / changes, if any, on the equipment being returned to service:

3. **CLEARANCE CERTIFICATE:**

I hereby declare that all men and material have been withdrawn. The original settings of equipment/ relays have been restored. Relays have been put in their cases with covers. Test plugs have been restored. CT, PT & DC circuits have been made through.

The following exceptions are recorded:

- i)
- ii)

Name:  
Designation of Shift - In - Charge:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

**E. CANCELLATION OF PTT:**

1. PTT cancelled and entry made in PTT register on Page No. \_\_\_\_\_.
2. SEQUENCE OF NORMALIZATION :  
i)  
ii)  
iii)  
iv)

Name  
Designation of Shift - In - Charge:  
Date:- \_\_\_\_\_ Time:- \_\_\_\_\_

Signature \_\_\_\_\_

## CHAPTER -5

### RVPN SAFETY INSTRUCTIONS 01 (RSI - 01)

#### EHV AND HV SWITCHING, EARTHING AND SAFETY DOCUMENT PROCEDURE

##### 5.1 PURPOSE

When maintenance or testing is to be carried out on RVPN's/ Concessionaire's EHV / HV System, procedures need to be specified to achieve safety from the system.

##### 5.2 SCOPE

This RVPN Safety Instructions set down the procedure to be adopted when carrying out EHV / HV switching, isolation from other supplies, earthing, issue of Safety Document and control on RVPN's/Concessionaire's EHV / HV Transmission System.

##### 5.3 PROCEDURE

- i) When work is to be carried out on or near EHV / HV equipment, the Maintenance Engineer and the Shift - In - Charge will assess the means of achieving safety from the system. Refer Safety Rule 4.3(i) (a).
- ii) When the work on the substation equipment / transmission line requires the providing of primary earths, then the safety document issued must be a Permit To Work. Refer Safety Rule 4.3(ii) (a).
- iii) When the work / testing on the substation equipment/ transmission line do not require the providing of primary earths, then the safety document issued must be a Permit To Test. Refer Safety Rule 4.3(ii) (b).
- iv) Within any isolated zone, any number of PTWs may be issued at the discretion of the Shift Incharge. Refer Safety Rule 4.3(ii) (d).
- v) Within any isolated zone, only one PTT shall be in force at any time. No PTWs are permitted at the same time as the PTT is in force in the same isolated zone. Refer Safety Rule 4.3(ii) (e).
- vi) After agreement has been reached between the Sub Station Shift - In - Charge and the SLDC that the shutdown on the specified substation equipment / transmission line can be availed, the Maintenance Engineer requests the shutdown by completing all items of Request for the Permit To Work or Permit To Test (Part A).
- vii) The SLDC will confirm to the Shift - In - Charge that the shutdown can be availed and both will record the instructions in their log sheet(s) together with the message number, date and time that the instruction was given.
- viii) The Shift - In - Charge will carry out switching operations as per the instructions of SLDC. He shall also give a message to the Shift - In - Charge of the Sub Station at the other end(s) for carrying out such switching operations as are necessary for isolation of the work / test area. These switching operations will be recorded in the substation log sheet(s) together with message number, the date and time.

- ix) If, during a switching operation, a piece of equipment shows any sign of distress, switching must cease immediately and the Sub Station – In - Charge notified. All persons must be warned that a potential hazard exists.
  
- x) In the case of lines or equipment where isolation and / or earthing is required from the other end, the Shift – In – Charge of the Sub Station where PTW / PTT has been applied for shall obtain the ‘Earthing Certificate’ / ‘No Feed Back Certificate’ / PTW / PTT from the other end(s).
  
- xi) The Shift - In - Charge of the Sub Station where the PTW / PTT has been applied for will then carry out all isolation and will Lock Open these points of isolation. In case of Line, the Shift - In - Charge shall give a message to the Shift – In – Charge of the Sub Station at the other end(s) for carrying out isolation and locking open the points of isolation. The Shift – In – Charge of the Sub Station at the remote end will then isolate and Lock Open all points of isolation and confirm back to the Shift - In - Charge of the Sub Station where the PTW / PTT has been applied for. Any isolation of the secondary side of voltage transformers and auxiliary transformers (tertiary winding where applicable) will also be carried out including locking. These switching operations will be recorded in the substation log sheet(s) together with message number, date and time that instruction was given.
  
- xii) Once all isolation including voltage transformers and auxiliary transformers (tertiary winding where applicable) has been completed, including remote ends where necessary, and confirmation has been received that the isolation has been completed at the remote end, earth switches shall be closed and Locked. Caution Notices shall be fixed on all control handles on the control panel and also attached to the padlocks used to Lock Open all points of Isolation and Lock Closed all earth switches. These switching operations will be recorded in the Sub-station log sheet together with message number, date and time.
  
- xiii) ‘No Back Feed Certificate’ / ‘Earthing Certificate’ must be obtained from all concerned Sub Stations. All details of the ‘No Back Feed Certificate’ / ‘Earthing Certificate’ must be entered in the Sub Station log sheet along with message number, date and time. The message number, date and time must also be recorded on the PTW / PTT.
  
- xiv) The Shift – In - Charge at the Sub Station(s) where the Permit(s) to Work or Permit(s) To Test are to be issued shall record the isolation and earthing in Part B.1 of the Permit To Work or Permit To Test (Sequence of Isolation).
  
- xv) All Safety Keys, fuses and links, etc, which have been used to Lock all points of isolation and earth switches, etc. will be Locked in a Key Safe under the safe custody of the Shift - In - Charge.
  
- xvi) The Shift - In - Charge will specify the following in Part B of the Permit To Work or Permit To Test before issue:
  - a) Any further precautions which are required to be taken later by the Incharge holding the Permit To Work or Permit To Test to achieve Safety {Refer Safety Rule 4.3(ii) (b)}.



- b) The power supplies that can be resorted for the particular work being carried out {Refer Safety Rule 4.3(ii) (e)} and issue the Approved written procedure.
  - c) The number of Additional Earths required. The use of these Additional Earths will be specified on an Earthing Schedule drawn up by the Maintenance Engineer.
- xvii) The Shift - In - Charge will issue the Permit To Work or Permit To Test to the Person requesting for PTW / PTT who will retain the Safety Document in his possession until all work has been completed. The Shift - In - Charge will record all the details in the substation log book and Permit To Work or Permit To Test register. In cases where PTW / PTT has been requested over telephone, the confirmation of conveying the approval of the PTW / PTT shall be recorded by the Shift – In – Charge.
- xviii) a) The Person requesting for PTW / PTT will sign Part C (Receipt) to accept the responsibility for carrying out the work / testing on the Sub Station equipment / transmission line. The Person responsible for the work / testing will draw up the Earthing Schedule, if required, to show the position and use of Additional **Earths**.
- b) IMPORTANT:- In cases where PTW / PTT has been requested over telephone, the person responsible for the work / testing shall give confirmation of receipt of the approval of the PTW / PTT by giving a “code name” which shall be not be recorded by the Shift – In – Charge. The Shift – In – Charge shall verbally convey the “code name” to the next Shift–In-Charge.
- xix) a) In substations, Additional Earths must be applied in a manner similar to primary portable earths using the same earthing equipment.
- b) On overhead transmission lines, Additional Earths can be applied within Safety Clearance but at not less than Safe Electrical Clearance as specified in Safety Instructions 05.
- xx) a) On completion of the work, the person who has obtained the PTW / PTT will sign the Return of Permit To Work or Permit To Test (Part D) to declare that all work / testing is completed. The person who has obtained the PTW / PTT over telephone shall convey the above along with the “code name” given by him at the time of obtaining the PTW / PTT.
- b) **While** returning the PTW / PTT, any restrictions applicable / changes made **shall be described in part D. It shall also be confirmed** that all men, tools, plant and Additional Earths have been removed.
- xxi) The Shift - In - Charge will receive / accept the cleared Permit To Work or Permit To Test and record receipt in the substation log sheet. He will also record the receipt / acceptance in the Permit To Work or Permit To Test register together with date and time, and mention this in Part E.1 of the PTW / PTT.
- xxii) The Shift - In - Charge will verify the local status and then carry out the removal of all the Primary Earthing and switching operations after consultation with SLDC and remote end(s), recording these in the substation log sheet together

with date and time. He will complete Part E.2 of the Permit To Work / Permit To Test to describe the sequence of normalization.

- xxiii) The Shift - In - Charge shall cancel the PTW / PTT by signing in Part E. The PTW / PTT shall then be kept for record.

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## CHAPTER -6

### RVPN SAFETY INSTRUCTIONS 02 (RSI – 02).

#### DEMARCATION OF WORK AND TESTING AREAS IN SUB STATIONS

##### 6.1 PURPOSE.

Before any work / testing is carried out in or adjacent to a charged substation area, the work or test area is to be clearly demarcated. (Refer Safety rule 4.7).

##### 6.2 SCOPE.

This RVPN Safety Instructions sets down the procedures to be adopted for the demarcation of work / test areas in substations.

##### 6.3 EQUIPMENT IDENTIFICATION.

Equipment on which work or test is to be carried out must be readily identifiable. Where necessary, a means of identification must be fixed to it. This will remain effective throughout the course of the work.

##### 6.4 DANGERS.

The main Dangers to personnel working in substations are electric shock, burns or falls arising from:

- i) The possibility of mistaking Equipment on which it is unsafe to work for that on which it is safe to work.
- ii) Inadvertently infringing Safety Clearance.
- iii) Taking inadequate precautions to suppress or safely discharge any induced or other impressed voltages on the Equipment.
- iv) Insecure hand and footholds.
- v) Failure to make proper use of personal protective equipments.
- vi) Sudden rush of flying insects, viz., Bees, flying ants, etc.

##### 6.5 WORK / TESTING.

- i) When work or testing is to be carried out on or near to Equipment in a substation, the area demarcation is to be determined by the Maintenance Engineer / Testing Engineer to the satisfaction of the Shift - In - Charge.
- ii) Work / testing in a substation must be carried out under the supervision of a Maintenance Engineer / Testing Engineer.

##### 6.6 DEMARCATION OF WORK / TESTING AREAS.

- i) Where work is to be carried out near to Equipment which may be Live, or must be regarded as Live, then the limits of the work area must be defined as per Rule 6.5 (i) above and followed for Safety Distance as per Rule 4.2 (ii) of the Safety Rules.

- ii) Boundary marks must be clearly identifiable and easy to see. They must be fixed or moved by maintenance personnel under the supervision of the Maintenance Engineer / Testing Engineer and Shift - In - Charge.
- iii) Boundary marking
  - a) should be properly fixed / supported.
  - b) may be attached to any structure supporting Equipment.
  - c) should not carry any notice.
- iv) In general, the boundary marking must be arranged so that it is impossible to climb, from within the work area, on structures supporting Equipment which is Live. Where this is not possible, red Danger notices must be attached at working level, before work commences, to identify the structures.
- v) The boundary of the work / test area must be identified by using red and white plastic chain or nylon rope / tape of about 12 mm diameter /width.
- vi) Safety Distance must be maintained at all times to Equipment on which it is unsafe to work. This includes any overhead conductors that pass over the work area or adjacent live equipment on which work is not to take place.
- vii) The demarcation equipment can be erected after safety precautions have been established but must not be erected before the issue of the PTW / PTT.
- viii) The demarcation equipment shall be removed only after the clearance of the PTW / PTT.
- ix) Consideration should be given, if thought necessary by the Maintenance Engineer / Testing Engineer, for providing physical protection to personnel from hazards in the System adjacent to the demarcated area.

#### **6.7 DANGER NOTICES.**

- i) Danger Notices must be placed to inform personnel that adjacent Equipment is not included in the specified work area. The notices must be attached to or fixed adjacent to adjoining Equipment in sufficient numbers to be visible from the work area at all times.
- ii) Danger Notices must only be fixed or moved by maintenance personnel under the supervision of Maintenance Engineer / Testing Engineer and Shift - In - Charge.

#### **6.8 HAZARD AREAS.**

Hazard Areas may be barricaded off by using yellow and black plastic / nylon chain / rope / tape.

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## **CHAPTER -7**

### **RVPN SAFETY INSTRUCTIONS 03 (RSI – 03).**

#### **TESTING OF EXTRA HIGH VOLTAGE AND HIGH VOLTAGE EQUIPMENT**

##### **7.1 PURPOSE.**

When testing is to be carried out on EHV / HV Equipment, procedures need to be specified to achieve safety from inherent Dangers.

##### **7.2 SCOPE.**

This safety instruction applies the principles established by the safety precautions to achieve safety from the system for personnel during the testing of EHV / HV Equipment.

##### **7.3 EQUIPMENT IDENTIFICATION.**

Equipment on which testing is to be carried out must be readily identifiable. Where necessary, a means of identification must be fixed to it that will remain effective throughout the course of testing. Refer Safety Rule 4.3(i) ( b).

##### **7.4 DANGERS.**

The main dangers to personnel during the course of testing are electric shock, burns and other injuries arising from

- Accidental contact with LIVE Equipment.
- Electrical energy, mechanical pressures and forces derived from testing sources.

##### **7.5 PREPARATIONS FOR TESTING.**

- i) Testing must be carried out by competent trained Personnel.
- ii) Testing which requires the application of primary earth must be carried out under a Permit To Work.
- iii) Testing which does not require the application of primary earth may be carried out under a Permit To Test.
- iv) Further precautions, e.g., “Fire Fighting equipment to be immobilized”, must be stated on the Safety Document in accordance with RVPN Safety Instruction 01 (RSI 01).
- v) The test area and its boundaries and limits must be identified in accordance with the Safety Instruction “Demarcation of Work and Testing Areas in Substations.”(RSI - 02)
- vi) Points of Isolation must be maintained from all supplies other than those required for the tests.

## **7.6 TESTING**

- i) The Competent Person in receipt of the appropriate Safety Document is responsible for all matters of safety concerned with the test and for the control functions within the test area. He may operate or instruct others to operate the equipment within the test area.
- ii) If specified on the Permit To Test, the Competent Person may remove, replace or instruct others to remove or replace Primary Earths.
- iii) Connections used for test purposes must be of adequate capacity and easily visible to prevent accidental access / contact.
- iv) The application of the test supplies must be done under the supervision of the competent person who has received the safety document.
- v) Equipment which is associated with a test and likely to have retained an electrical charge must be discharged to earth before and after the application of the test supply.
- vi) Where a test voltage is to be applied to equipment which has a remote end that may become live, then that end must be safeguarded / got isolated so as to prevent danger. A 'No Back Feed Certificate' / Permit To Test must be obtained from such remote end.
- vii) If the remote end of the equipment which may become live by the test voltage is accessible, then it is the responsibility of the competent person carrying out the test to ensure that it is barricaded off and under the control of a competent person at the remote end before a test voltage is applied. It is the responsibility of the person at the remote end to ensure that no one including himself approaches the equipment unless instructed to do so by the competent person Incharge of the testing at the other end.

## **7.7 COMPLETION OF TESTING.**

When a safety document which includes testing as part of the work activity is to be cleared, the competent person must ensure that any safety precautions that were varied / modified for the testing and are not restored to the original state are listed as exceptions.

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## CHAPTER -8

### RVPN SAFETY INSTRUCTIONS 04 (RSI - 04)

#### LOW VOLTAGE AND MEDIUM VOLTAGE EQUIPMENT

##### 8.1 PURPOSE

When work or testing is being carried out on LV / MV Equipment, procedures need to be specified to achieve safety from inherent danger.

##### 8.2 SCOPE

These RVPN Safety Instructions apply the principles established by the Safety Rules to achieve Safety from the System for personnel working or testing on Low / Medium Voltage (LV / MV) Equipment.

##### 8.3 EQUIPMENT IDENTIFICATION

Equipment on which work or testing is to be carried out must be readily identifiable. Where necessary a means of identification must be fixed to it which will remain effective throughout the course of the work. Refer Safety Rule 4.4(ii) (a).

##### 8.4 DANGERS

The main Dangers to personnel working or testing on LV/MV Equipment are electric shock or burns arising from

- i) The possibility of personnel mistaking Equipment on which it is unsafe to work for that on which it is safe to work.
- ii) The possibility of the Equipment being worked on accidentally or inadvertently being made Live.
- iii) Dangerous voltages on open - circuited current transformer.
- iv) Vicinity of the LV / MV circuit / conductor due to less clearance specially in LT switch gear.

##### 8.5 GENERAL REQUIREMENTS.

- i) Where reasonably practicable, the preferred method is to work on or near to LV / MV Equipment which is Dead. Refer Safety Rule 4.4 (i). Work on Live LV / MV Equipment should rarely be permitted, but where no alternative method is possible, work can be carried out as in section 5 of this Safety Instruction. Refer Safety Rule 4.4(iii).
- ii) A Sub Station - In - Charge must carry out an assessment to determine under what conditions the work is to take place and if a Safety Document is to be issued. When Safety Document is issued, type & shape of Safety Document shall be as per Safety Rule 4.4(ii) (c).
- iii) When work is to be carried out on LV / MV Equipment which is part of Extra High Voltage / High Voltage Equipment, adequate precautions must be taken to achieve Safety of such LV / MV equipments from the EHV / HV Equipment.

- iv) When tests are to be carried out on LV / MV Equipment which is in proximity to exposed EHV / HV Equipment which may be Live, or may become Live, the relevant requirements of RVPN Safety Instruction “Demarcation of work and testing areas in Substations” (RSI - 02) must be met.
- v) When work on live equipment requires portable instruments to be used for voltage or resistance measurements, the instruments must be provided with insulated probes.
- vi) When working on protection or metering equipment, extreme care must be taken not to open circuit the secondary winding of current transformers. These must be short - circuited before work is carried out.

#### **8.6 Work / Testing on / or Near to Dead LV/MV Equipment.**

- i) Sub Station – In – Charge must assess the work required on / or near to the dead LV/MV equipment and decide whether it must be carried out under:
  - a) Permit To Work, or
  - b) Personal supervision
 Refer Safety Rule 4.4(ii) (c).
- ii) Equipment must be isolated. Time switches, float switches, thermostats, sequence switching devices or similar automatic switching devices are not isolating devices.
- iii) Points of isolation must be established. Any fuses and links and / or safety keys used to secure the points or isolation must be retained in a key safe. Refer Safety Rule .4.2.
- iv) Where work is to be done on portable or hand held LV / MV equipment, isolation must be achieved by the removal of the plug from the socket outlet.
- v) The work must be carried out by a competent person.
- vi) Before commencing work, the competent person must check, by means of an approved voltage testing device that the LV / MV equipment on which he is to work is not live. The device must be tested immediately before and after use.
- vii) If the work is interrupted, the competent person who is to continue the work must recheck, as described in .8.6(vi) above, that the equipment is not live.
- viii) Before commencing work on exposed LV / MV overhead conductors which have been isolated, in addition to proving that they are not live, the conductors including the neutral, must be short circuited and earthed.

#### **8.7 WORK OR TESTING NEAR TO LIVE LV / MV EQUIPMENT**

- i) Work near to live LV / MV equipment must only proceed after a satisfactory assessment by Sub Station – In - Charge.
- ii) The work must only be done by a competent person.
- iii) The competent person who is to do the work must first remove all metallic objects such as wrist watch, rings, wristlets, cufflinks and pendants, etc. from his / her body.



- iv) When necessary to prevent injury, approved insulated tools, insulating stands, mats or gloves as appropriate must be used.
- v) Only suitable test instrument with insulated test probes must be used.
- vi) Consideration must be given to the competent person being accompanied by another competent person if the presence of such a person could contribute significantly for ensuring that injury is prevented. Any accompanying competent person must be trained to recognize danger and if necessary to render assistance in the event of an emergency.
- vii) Before commencing work in areas where there is a possibility of the presence of gas which might be inadvertently ignited by electric sparks, the Sub Station – In - Charge must be consulted.

## **8.8 WORK ON LIVE LV / MV EQUIPMENT**

Refer Safety Rule .4.4(iii)

- i) Work on live LV / MV equipment is to be avoided as far as practicable.
  - ii) “If there is no alternative to working live”, then the following procedure must be adopted:
    - a) The Sub Station – In - Charge and the Maintenance Engineer must thoroughly review the requirement of the work.
    - b) A written procedure for the live work must be drawn by the Sub Station – In - Charge and the Maintenance Engineer in such a way that the procedure will comprehensively describe the precautions required to carry out the work.
    - c) Approved insulated tools and equipment must be specified and provided.
    - d) The work will be carried out only under the direct supervision of the Maintenance Engineer.
  - iii) When this work also involves working on or near to EHV / HV or mechanical equipment, the requirements of Safety Rules 4.2, .4.3, .4.5 and .4.7 must be met.
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## CHAPTER -9

### RVPN SAFETY INSTRUCTIONS 05 (RSI - 05)

#### WORK ON EXTRA HIGH VOLTAGE OVERHEAD LINES

##### 9.1 PURPOSE

When work is to be carried out on lines with one circuit de - energized and the other circuit energized, it is necessary to provide safe working conditions to enable the work to be carried on the de - energized circuit. This is also applicable for all lines whether single circuit or double circuit.

##### 9.2 SCOPE

This Safety Instruction sets down the procedure to be adopted when carrying out maintenance on a de - energized circuit of an EHV transmission line. It does not provide for work on live circuits.

##### 9.3 DEFINITIONS

- i) **Earth End Clamp** - The End Clamp of an Additional Earth which is to **be** connected to tower members, cross arm members or a suitable earth spike driven into the ground at ground potential.
- ii) **Line End Clamp** - The End Clamp of an Additional Earth which is to be connected with the conductor or jumper.
- iii) **Earth Lead** - A lead made of copper or aluminum strands protected with a cover for connection between the Line End Clamp and the Earth End Clamp.
- iv) **Socket** - The sliding socket for holding and operating the Line End Clamp which is a part of a Telescopic Pole or Bridging Pole.
- v) **Earthing Pole** - An insulated pole with a Socket which is to be used for tightening the Line End Clamps on to conductors or jumpers while maintaining Safe Electrical Clearance.
- vi) **Working Phases** - The conductor phases on which Linemen will carry out work.
- vii) **Field Equipment Earth** - Approved connections for bonding of items of field and access equipment such as scaffold, hydraulic platforms, mobile cranes, winches, etc. to earth. The earths are coloured orange to identify them from Additional Earths and are not included on an Earthing Schedule. They shall have a minimum cross sectional area of 35 sq. mm copper equivalent. An additional earth can be used in the form of field equipment earth.

##### 9.4 DANGERS

**The main Dangers when working on transmission lines are:**

- i) The possibility of personnel mistaking identification of the circuit on which it is safe to work with the one that is still energized.

- ii) Infringing Safety Clearance before Additional Earth is applied.
- iii) Inadequate precautions to exclude any induced voltages present on the conductors or fittings.

#### **9.5 GENERAL PRECAUTIONS TO BE TAKEN BEFORE CLIMBING OR WORKING ON TRANSMISSION LINE TOWERS OR WORKING ON CONDUCTORS.**

These general safety precautions are to be taken in addition to the safety precautions detailed in Schemes 1 to 5.

- i) One responsible officer (supervisor/ engineer) should always be present at the site of work.
- ii) The "CIRCUIT UNDER SHUT DOWN" as per PTW should be identified at the working location(s) with the help of a circuit plate or any other reliable method.
- iii) All Linemen who work on the transmission line towers, conductors or fittings, shall wear and make use of all safety belts / harnesses and other safety equipment provided for their safety and protection.
- iv) The Supervisor/ Engineer shall keep a constant vigil on the linemen climbing on the towers and give them directions in a manner to ensure that they climb only on the side/ portion of the tower on which it is safe to carryout work.
- v) Additional earths shall be carried on the tower in gunny / suitable bags to avoid any damage to the additional earths. Alternatively, the additional earths can be carried manually by the Linemen on their shoulders or raised up **by** using rope.
- vi) Safe electrical clearance shall be maintained by all Linemen until all the additional earths are correctly connected to conductors or jumpers of circuits under shut down.
- vii) All earth end clamps of additional earths shall be connected first to the tower / cross arm member at the point where the Lineman is standing or sitting in order to apply the additional earths. This earth end clamp shall, as far as possible, be connected at a point between the Lineman and the line end clamp.
- viii) After connection of the earth end clamps with the tower / cross arm members, all line end clamps shall be connected to conductor or jumper from the point where lineman is sitting or standing.

**(NOTE)** To ensure that a proper connection of the line end clamps with the conductor or jumper has been made, a check of the tightness by attempting to rotate the line end clamps on the conductor or jumper should be made by use of the earthing pole.

- ix) The earthing pole / bridging pole shall be kept suitably on the tower after connection of the line end clamps until disconnection of all additional earths.
- x) If during working on conductors, jumpers, insulators or fittings, an earth end clamp or line end clamp of an additional earth becomes disconnected for any reason, the Lineman must shift away from tower / cross arm members to maintain safe electrical clearance. He must not touch the disconnection end of the additional earth and should maintain safe electrical distance from the

disconnected end of the additional earth. In such a case, an extra additional earth shall be fitted in parallel with the faulty / disconnected earth. Then the disconnected additional earth shall be removed by the use of the earthing pole.

- xi) After completing the work, all tools, plant and men shall be removed from the conductors and fittings. The last Lineman shall remove the line end clamps from the conductors / jumpers while sitting or standing at the point of or behind the connection of these additional earths to the tower / cross arm side. After this, the earth end clamps shall be removed. This procedure shall be repeated for the disconnection of all other additional earths.
- xii) On completion of work, the additional earths shall be carried to the ground from the tower in gunny / suitable bags or lowered to ground using rope to avoid any damage to the additional earths. To avoid damage, the additional earths should not be thrown from the tower.
- xiii) While coming down from the tower, the Linemen shall remove the red flags and the green flags.
- xiv) One No. spare additional earth should be carried to the working tower to provide a spare in case of any contingencies.
- xv) **Isolation of line reactors:** To reduce induced voltage on the dead circuit of transmission lines, isolate line reactors at both ends of lines (wherever provided) in the dead circuit. This shall be done before closing earth switch at line ends of the dead circuit.

## 9.6 SCHEME 1

### WORK ON TOWERS WHICH DOES NOT INVOLVE THE DISCONNECTION OF CONDUCTORS OR JUMPERS

#### A Work

For work on the de - energized circuit of transmission line which does not involve the disconnection or lowering of any conductors to the ground. This scheme is to be followed during carrying out the following works:

- i) Changing suspension insulators.
- ii) Any other work on a suspension string.
- iii) Fixing / replacing of spacers or vibration dampers adjacent to the suspension or tension string.

#### B Procedure

- i) Apply general procedures as in section 9.5 of this Safety Instructions.
- ii) Apply additional earths to all phases and to all sub conductors (wherever applicable) at the working tower of the de - energized circuit.
- iii) As an extra safety measure, both sub conductors of working phase(s) may be bridged with an additional earth.
- iv) Carry out the maintenance of strings and vibration dampers as per normal procedure. However, if a winch is used for replacement of insulators, the winch must be earthed by the use of a fitted equipment earth attached to an earth spike driven to the ground. All line pulleys used should have good electrical connection with the tower. The pulleys should not have any insulation, i.e., rubber lining, etc.

**(NOTE)** Conductors can also be earthed at adjacent towers instead of bridging the sub conductors as extra safety measures.

## 9.7 SCHEME 2

### BREAKING AND REMAKING JUMPER CONNECTIONS

#### A Work

For work on the de - energized circuit which does not involve the disconnection or lowering of conductors between towers to the ground. This scheme is to be followed after earthing for the following work on tension towers:

- Breaking or remaking jumper connections, including lowering and raising a jumper.

#### B Procedure

- i) Apply general procedures as in section 9.5 above.
- ii) Even if only one end of the jumper is to be disconnected, additional earths must be provided on both side of the tower at both ends of the conductors on line side of the dead end compression joints.
- iii) Apply additional earths to all phases and to all sub conductors (wherever applicable) on the jumpers at the working tower of the de - energized circuit.
- iv) Apply additional earths on all working phases and on all sub conductors (wherever applicable) on adjacent towers.
- v) Disconnect the jumpers from one or both ends as applicable.
- vi) If the jumper is to be lowered to the ground, disconnect the line end clamp of the additional earth from the jumper before lowering the jumper to the ground. The disconnected additional earth shall be kept suitably at tower cross arm.
- vii) Lower the jumper in such a way that safety clearance is maintained from all live conductors.
- viii) Before any person on the ground touches the jumper, it should be discharged by the use of an additional earth connected to the tower leg or fixed to an earth spike driven into the ground.
- ix) Carry out the maintenance work on the jumpers as per normal procedure.
- x) Raise the jumper to the cross arm maintaining safety clearance from all live conductors. Precautions shall be taken so that the jumper is not raised in the horizontal position.
- xi) The additional earth shall be applied to the jumper for connecting it to the dead end compression joints.
- xii) Connect the jumper at both ends with dead end compression joints.

## **9.8 SCHEME 3**

### **WORK ON CONDUCTORS BETWEEN TOWERS:**

#### **A WORK**

For work on the de - energized circuit which does not involve the disconnection or lowering of conductors to the ground. This scheme is to be followed after earthing for the following works.

- i) Fixing / repair of line spacers.
- ii) Fixing / repair of rigid spacers.
- iii) Fixing / repair of line spacer dampers.

#### **B Procedure**

- i) Apply general procedures as in section .9.5 above.
- ii) Apply additional earths on all phases on towers at both the ends of working zone. These towers should not be more than 10 spans apart. At tension tower(s) within the working zone, apply additional earths to the jumpers.
- iii) Carry out the maintenance work as per normal procedure. While working, following safety precautions shall be taken.
  - a) The men on the conductor shall always maintain safe electrical clearance from tower steel parts or any other material at earth potential at those towers where conductor is not earthed.
  - b) If any tool or plant is required by the Lineman on the conductors, they shall be lifted to the working position by using a poly propylene / insulated rope/ bag.
  - c) If access to any tower is required, all the conductors at that tower shall be earthed with additional earths.
  - d) If, before work commences, there is a risk of thunder / lightning stroke, no work shall be started. If during the course of work, there is a risk of thunder / lightning stroke, all work shall immediately stop and all men shall return to the ground.

## **9.9 SCHEME 4**

### **PAINTING OF TOWERS WHICH DOES NOT INVOLVE ANY DISCONNECTIONS AND ANY ACCESS TO CONDUCTOR**

#### **A Work**

For work on the de - energized circuit which does not require any contact with insulators, associated fittings or conductors. This scheme is to be followed after earthing for the following works:

Painting of:

- i) Single circuit towers.
- ii) Double circuit towers upto vertical centre line of tower towards the de - energized circuit.

#### **B Procedure**

- i) Apply general procedures as in section .9.5 above.
- ii) Apply additional earths on all phases on sub conductors (wherever applicable) of the de-energized circuit not more than ten towers apart. At tension tower(s), the additional earths shall be connected to the jumpers.
- iii) In case only one or two towers are to be painted, only the working towers need to be earthed as per normal procedure of earthing for suspension or tension towers as the case may be.
- iv) Carry out the painting work on towers as per normal procedure.



## 9.10 SCHEME 5

### **RAISING AND LOWERING PHASE CONDUCTORS AT SUSPENSION TOWERS. FITTING REPAIR SLEEVES/ JOINTS TO PHASE CONDUCTORS.**

#### **A Work**

For work on the de - energized circuit of a transmission line which involves raising and lowering phase conductors and the fitting of repair sleeves / joints to the phase conductors. This scheme is to be followed after earthing for the following works:

- i) Lowering of conductor at suspension tower.
- ii) Raising of conductor at suspension tower.
- iii) Providing the repair sleeves on the lowered conductor.
- iv) Cutting and jointing of lowered conductor.

#### **B Procedure**

Apply general procedures as in section .9.5 above.

##### **i) LOWERING AND RAISING CONDUCTORS.**

- a) Additional Earths shall be fixed on all phases of conductors at the suspension towers and at both the adjacent towers.
- b) If a manual winch is used, it shall be earthed to the tower using a Field Equipment Earth.
- c) All the pulleys used should have good electrical connection with the tower. The pulleys should not have any insulation, i.e., rubber lining, etc.
- d) Connect the rope with the conductor through pulley at suitable places in the tower and through winch.
- e) If scaffolding is used in the span below conductor, the scaffolding shall be earthed by providing an earth spike.
- f) Before lowering the conductor, the Additional Earth(s) shall be removed from that conductor and the Additional Earth(s) shall be kept suitably at the tower.
- g) When the lowered conductor is at approx. four meters from ground, additional earth(s) shall be applied from ground spike / tower on to the lowered conductor(s).
- h) When on the ground and the conductor has to be cut, Bridging Earth(s) shall be provided on both sides of cutting point with ground spike or tower legs. Then as per working procedure, the conductor shall be cut and joined. After joining the conductor, the Additional Earth(s) shall be removed.
- i) The conductor(s) shall be raised up to 4 meters height from ground and additional earth(s) shall be removed.
- j) Raise the conductor(s) up to the cross arm level and apply the additional earths on the conductors.

k) On completion of work, remove all additional earths.

**ii) RAISING CONDUCTOR FOLLOWING BREAK DOWN**

- a) Additional Earths with ground spike shall be fitted to all conductor phases at the towers on either side of break down point and either side of work area. In case lowering of conductors from adjacent suspension towers is required, follow the procedure of lowering the conductors given at 9.10 (B)(i) of this procedure above. If conductor is required to be lowered from tension towers, then follow Scheme No.6.
- b) If a manual winch is used for lowering or raising conductor(s), it must be earthed on the tower or by the use of a Field Equipment Earth attached to an earth spike driven into the ground. All the pulleys used should have good electrical connection with the tower. The pulleys should not have any insulation, i.e., rubber lining, etc.
- c) After raising the conductor up to 4 meter from ground, remove additional earths from the conductors.
- d) After raising the conductor up to the cross arm level, all Additional Earth(s) should be attached to the conductor.
- e) After completion of work, additional earths shall be removed.

## 9.11 Scheme 6

### LOWERING AND RAISING OF CONDUCTOR AT TENSION TOWERS

#### A Work

For work on the de - energized circuit of a transmission line which involves lowering and raising phase conductors and the fixing of repair sleeves / joints to the phase conductors. This scheme is to be followed after earthing for the following works:

- i) Lowering of conductor at tension tower.
- ii) Raising of conductor at tension tower.
- iii) Providing the repair sleeves on the lowered conductor.
- iv) Cutting and jointing of lowered conductor.

#### B Procedure:

##### LOWERING AND RAISING OF CONDUCTOR

- i) Apply general procedures as in section .9.5 above.
- ii) Follow Scheme 2 for disconnection of jumpers. While following Scheme 2, care shall be taken for providing bridging earth which shall be connected to the tower side yoke plate / maintenance block and on to conductors.
- iii) Provide long additional earths from ground spikes on the conductor of the phase wire which is to be lowered / raised. Remove the additional earths connected from the tower to the conductor.
- iv) Lower the conductor to the ground along with the additional earths connected to the ground spikes.
- v) Provide additional earths on either side if cutting of the conductor is to be done for jointing purpose.
- vi) After repair work, raise the conductor up to cross arm level along with the additional earths connected to the ground spikes.
- vii) Connect the additional earths provided on the towers and remove all additional earths connected to the ground spikes.
- viii) Follow Scheme 2 for making jumper connections.
- ix) After completion of work, remove all additional earths.

## **9.12 Scheme 7**

### **WORK ON EARTH WIRE**

#### **A Work**

Replacement of vibration dampers & copper bonds, and tightening of bolts and nuts of clamps, etc.

#### **B Procedure**

- i) No earthing procedure is required in case of Double Circuit towers or single circuit towers in delta configuration as no shutdown is to be taken for climbing on these types of towers.
- ii) For 400 KV single circuit towers with horizontal configuration of conductors, follow the earthing requirements as per Scheme 1 for both suspension towers and tension towers.

### 9.13 Scheme 8

#### WORK ON EARTH WIRES AFTER BREAK DOWNS

##### A Work

Jointing and raising of earth wire after break down.

##### B Procedure

- i) Obtain the shut down of the affected circuit in case of 400 KV double circuit line, and shut down of the line(s) in case of single circuit lines and other double circuit line.
- ii) Provide earthing as per Scheme 1 on all towers which are required to be climbed.
- iii) Provide additional earths connected to earth spikes on the earth wire ends (2 Meters away from ends) before starting the job for mid span joints.
- iv) During rigging, the pulley used at the cross arm / peak end shall be provided with additional earth connected to the cross arm / peak. This is required if fibre round / polypropylene rope sling has been used in place of wire rope sling for fixing the pulley.
- v) Carry out the repair and maintenance work on the earth wire.
- vi) Raise the earth wire upto 4 meters height from ground and then remove additional earths connected to earth spikes.
- vii) Use extreme caution when raising the earth wire in case of 400 KV double circuit lines **so that** the required safety clearance **is always maintained**.
- viii) Raise the earth wire upto cross arm / peak level.
- ix) Remove all additional earths on completion of work.

## 9.14 Scheme 9

### INSPECTION / PATROLLING OF TOWERS AND LINE MATERIALS / FITTINGS

#### A Work

- i) Inspection of complete single circuit towers under shut down.
- ii) Inspection of towers upto vertical centre line of double circuit towers towards circuit under shut down (only one circuit under shut down).
- iii) Inspection of all insulators, fittings, accessories, etc. of de – energized circuit of single circuit & double circuit lines.
- iv) Tightening of bolts & nuts, fixing split pins in suspension / tension hardware, etc.

#### B Procedure

- i) Follow system of earthing procedure as per Scheme 3 if inspection is being done by trolley work.
  - ii) Follow system of earthing procedure as per Scheme 1 in case access to any conductor point is needed from tower cross arm.
  - iii) Carry out minor works like tightening of bolts and nuts, fixing split pins, relocation of vibration dampers, etc.
  - iv) Remove additional earth after completion of inspection & minor works.
-

## CHAPTER -10

### RVPN SAFETY INSTRUCTIONS 06 (RSI - 06)

#### ACCESS TO EHV / HV COMPARTMENTS AND STRUCTURES

##### 10.1 Purpose

To control the access of personnel to EHV / HV compartments and structures.

##### 10.2 Scope

These RVPN Safety Instructions set down the procedures to control the access of personnel to enclosures, chambers, cubicles, cells containing exposed extra high voltage / high voltage conductors. It also includes access to towers, gantries or other means of supporting or giving access to such conductors.

##### 10.3 Definitions

- Access key:** A unique key for locking a device for preventing access to a compartment or structure.
- Compartment:** An enclosure, chamber, cubicle or cell designed to prevent and control access to equipment having exposed EHV / HV conductors.
- Structure:** A tower, gantry or other means of supporting or giving access to EHV / HV equipment / conductor.

##### 10.4 Equipment Identification

Each compartment or structure must be readily identifiable.

##### 10.5 Dangers

The main dangers to personnel working in compartments and on structures are electric shock, burns or falling. These can arise from accidental or unauthorized access and proximity to live EHV / HV conductors.

##### 10.6 Access to Compartments.

- i) Devices designed to prevent access to compartments must normally be kept locked.
- ii) Access keys for the locks must normally be kept locked in a box or cupboard under the control of Shift - In - Charge.
- iii) Only the Shift - In - Charge or operating personnel under his personal supervision must have access to a compartment in which the exposed EHV / HV conductors are live.
- iv) When work is to be done on EHV / HV equipment in a compartment, all the exposed EHV / HV conductors must have been isolated, points of isolation established, primary earths applied and a Permit To Work or Permit To test issued for the work. The lock controlling access to the compartment must be unlocked by the Shift - In - Charge.

## **10.7 Access to structures**

- i) Devices designed to prevent the climbing of structures must normally be kept locked or bolted.
- ii) Access devices must be opened only by the Shift - In - Charge under a specific PTW / PTT.



## CHAPTER -11

### RVPN SAFETY INSTRUCTIONS 07 (RSI - 07)

#### EQUIPMENT CONTAINING SULPHUR HEXAFLUORIDE (SF<sub>6</sub>)

##### 11.1 Purpose

To control inherent dangers involved in equipment containing SF<sub>6</sub>.

##### 11.2 Scope

These RVPN Safety Instructions apply the principles established by the Safety Rules to achieve safety from the system for personnel working on equipment which contains or has contained sulphur hexafluoride (SF<sub>6</sub>) gas.

##### 11.3 Definitions

**Gas zones:** Discrete pieces of equipment which may be independently isolated and drained of SF<sub>6</sub>. A gas zone may comprise of:

- A single phase enclosure.
- A single enclosure containing the three phases of an item of equipment.
- Three single phase enclosures of a common item of equipment connected by inter phase pipe work.

**“Point of Access” Notice:** An approved notice identifying initial points of entry to isolated and vented equipments (relevant to GIS only).

##### 11.4 Equipment Identification

- i) Equipment on which work is to be carried out must be readily identifiable. Where necessary, a means of identification must be fixed to it which will remain effective throughout the duration of the work.
- ii) Gas zones must be identified as per the layout of GIS.

##### 11.5 Dangers

The main dangers to personnel from equipment containing SF<sub>6</sub> gas are:

- i) Asphyxiation or suffocation.
- ii) Electric shock.
- iii) Burns.
- iv) The release of stored mechanical energy or pressure.
- v) Toxic breakdown products which can be formed within the equipment.

##### 11.6 Preparation for Work

- i) **Demarcation of work area:**  
The boundaries of the equipment on which it is safe to work must be clearly identified. This must be done in accordance with the requirements of RVPN Safety Instructions 02 (RSI - 02): “Demarcation of Work / Testing Areas in Sub Stations”.

ii) **When depressurization is not required:**

If depressurization is not required to allow work to be done, necessary precautions must be taken to achieve safety from the System by applying appropriate safety precautions followed by the issue of a Permit To Work or Permit To Test.

iii) **When depressurization is required:**

When depressurization is required, the following precautions must be taken to achieve safety from the system.

- a) The equipment must be drained of SF<sub>6</sub>. This must be carried out in accordance with the approved procedures relating to sulphur hexafluoride (SF<sub>6</sub>) gas.
  - b) A point of access notice must be displayed at each initial entry point (applicable for GIS). These notices must be fixed or moved only by maintenance personnel under the supervision of a Maintenance / Testing Engineer (Refer RSI - 02).
  - c) A Permit To Work or Permit To Test must be issued for the work to proceed and, where appropriate, the recommendations for general safety report must specify the further precautions to be taken to deal with any arc products which may be present. The removal and disposal of any arc products must be in accordance with the approved procedure relating to sulphur hexafluoride (SF<sub>6</sub>) gas.
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## CHAPTER -12

### RVPN SAFETY INSTRUCTIONS 08 (RSI - 08)

#### MOVEMENT AND OPERATION OF MOBILE ACCESS EQUIPMENT, VEHICLES, CRANES AND LONG OBJECTS IN SUB STATIONS

##### 12.1 Purpose

To provide safety from the hazards arising from movement of mobile cranes, vehicles, etc. within a charged switchyard.

##### 12.2 Scope

These RVPN Safety Instructions apply the principles established by the Safety Rules to achieve safety from the system when mobile access equipment, vehicles, cranes and long objects are being moved or used within Sub Stations containing exposed live EHV / HV equipment.

##### 12.3 Definitions

**Field equipment earths:** Approved connections for bonding items of field and access equipment such as scaffold, hydraulic platform, mobile crane, winches, etc. to earth. The earths are coloured orange to identify them from additional earths and not included on an earthing schedule. They shall have a minimum cross sectional area of 35 mm sq. copper equivalent.

**Long objects:** Items of equipment such as ladders, scaffold, poles, ropes, measuring tapes, etc. which, if not controlled during handling, could infringe safety clearance.

**Operator:** A person trained, assessed and appointed to use specific type of mobile access equipment, vehicle or cranes within energized Sub Stations.

##### 12.4 Equipment identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 12.5 Dangers

The main dangers to personnel during the movement and use of access equipment, vehicles, cranes and long objects in Sub Stations containing exposed live EHV / HV conductors are electric shock, buns or falling arising from:

- Infringing safety clearance.
- Induced voltages.

##### 12.6 USE OF MOBILE ACCESS EQUIPMENT, VEHICLE AND CRANES IN SUB STATIONS.

- i) When mobile access equipment, vehicles or cranes are to be used in Sub Stations, Maintenance / Testing Engineer on site must assess the risks.
- ii) The Maintenance / Testing Engineer shall ensure that the mobile access equipment is operated by a trained operator only.

#### **12.7 MOVEMENT OF MOBILE ACCESS EQUIPMENT VEHICLES AND CRANES TO AND FROM THE DEMARCATED WORKING AREA.**

- i) When mobile access equipment, vehicles or cranes are to be moved to and from the safe working area, and any part of this equipment in the transport position is higher than 2.3 meters from ground level, then a Maintenance / Testing Engineer must assess the risks.
- ii) The Maintenance / Testing Engineer must specify on site the route to be followed with adequate protection.
- iii) The Maintenance / Testing Engineer may also specify when during the movement, the mobile access equipment, vehicle or crane must be bonded to earth using field equipment earths.
- iv) The Maintenance / Testing Engineer, when deciding on the route to be taken, must also ensure that the bus bar zone protection wherever provided and adjacent circuit protection is in service.
- v) The Maintenance / Testing Engineer must provide personal supervision during the whole period of movement.
- vi) At no time must safety clearance be infringed.

#### **12.8 OPERATION OF MOBILE ACCESS EQUIPMENT, VEHICLES AND CRANES WITHIN THE DEMARCATED WORKING AREA.**

- i) Working area must be identified in accordance with RVPN Safety Instructions RSI – 02 ‘Demarcation of work / testing areas in Sub Stations’.
- ii) Approach to within safety clearance of equipment by mobile access equipment, vehicle or crane is only allowed under Permit To Work or Permit To Test.
- iii) The operator must ensure that effective use is made of any equipment stabilizing devices or outriggers.
- iv) The Maintenance / Testing Engineer holding the safety document must consider whether it is necessary to consult an appropriate qualified specialist (e.g., Civil Engineer) to ensure that safe ground bearing pressures will not be exceeded. This is particularly important where wheels, stabilizing legs or outriggers may need to be positioned over ducts. Where necessary, load spreading devices must be used.
- v) The recipient of the safety document must ensure that, as soon as practicable after reaching the demarcated working area, a field equipment earth is connected to the equipment.
- vi) The recipient of the safety document must satisfy himself that the operator knows what work is to be done and that the equipments controls are operating correctly.

- vii) The recipient of the safety document must consider whether to select member(s) of his working party as Safety Observer(s). He must assess the risks in relation to the work being done, the equipment being used, the field of vision of the operator and the proximity of exposed live EHV / HV equipment.
- viii) The Safety Observer(s) must use agreed signal for halting the movement of crane to avoid Danger.
- ix) Equipment provided for personnel access must be electrically bonded to the earthed EHV / HV equipment as near to the point of work as practicable to provide an equipotential zone. This can be achieved by connecting the access equipment through a field equipment earth to the same point as the primary earth or additional earth attached to the EHV / HV equipment. It is essential that there is an adequate bond between the access platform and the vehicle chassis.

## **12.9 SCAFFOLDING**

- i) The Maintenance / Testing Engineer must finalize, on the site, the movement route of scaffolding.
- ii) Subsequent movement of scaffolding to the required location must be carried out under the personal supervision of the Maintenance / Testing Engineer.
- iii) When moved in a Sub Station, long scaffolding components must be carried in a horizontal position and as near to the ground as possible.
- iv) Before scaffolding is erected or dismantled, the Maintenance / Testing Engineer must assess the risks in relation to the proximity to exposed live EHV / HV equipment.
- v) Field equipment earths must be applied to scaffolding erected near to the live EHV / HV equipment as soon as it is practicable to do so. As erection proceeds, Field Equipment Earths must be applied at approximately 5 metres (15 feet) intervals, vertically or horizontally or as determined by the Maintenance / Testing Engineer.
- vi) The recipient of the safety document must assess the risks in relation to the method of erection and the proximity to exposed live EHV / HV equipment. He must consider whether to select Safety Observer(s).
- vii) No bamboo / wooden scaffolding is to be used.

## **12.10 MOVEMENT AND USE OF LONG OBJECTS**

- i) Long Objects must be stored, moved and used in a controlled manner to ensure that they do not infringe Safety Clearance.
- ii) Umbrellas must not be carried in switchyard areas.

## **LADDERS**

- i) Only Approved ladders must be used which are of no greater length than is required for the work.
- ii) When not in use all ladders within substations must be securely Locked to a suitable anchorage.

- iii) Ladders for operational purpose must not be used without the permission of a Shift Engineer.
  - iv) The movement and erection of ladders must be carried out under the Personal Supervision of Shift Engineer / Maintenance Engineer.
  - v) When moved in a substation, ladders must be carried in a horizontal position and as near to the ground as possible.
  - vi) If ladders have to be moved within a defined safe working area after the initial placement, the movement must be carried out in accordance with the specific instructions of the Maintenance / Testing Engineer.
  - vii) Before use portable ladders provided to give access to fixed ladders which terminate above ground level must be Locked in position by a maintenance / testing engineer. These must remain Locked in position during the period the ladders are in use.
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## CHAPTER -13

### RVPN SAFETY INSTRUCTIONS 09 (RSI - 09)

#### EXTRA HIGH VOLTAGE / HIGH VOLTAGE STATIC CAPACITOR BANKS

##### 13.1 Purpose

The safety of personnel working on or testing EHV / HV static capacitor banks has to be ensured by the removal of stored energy.

##### 13.2 Scope

These RVPN Safety Instructions apply the principles established by the Safety Rules to achieve safety from the system including the removal of stored energy for personnel working on EHV / HV static capacitor banks.

##### 13.3 Definitions

**Rack:** An individual framework containing capacitors connected together.

**Capacitor Bank:** A group of capacitors consisting of a number of racks connected together. If the equipment consists of only one rack, the term capacitor bank will also apply.

**Shorting switch:** A fixed device for short circuiting the capacitors in racks to dissipate stored energy safely. It may also provide a direct connection to earth.

**Short Circuited Lead:** An approved (6 sq. mm, **copper equivalent** 1.1 KV insulation) lead with insulated clips or a standard lead supplied by the manufacturer for this purpose. This is used for short-circuiting an individual capacitor. This can be a clip – on type lead used during the disconnection of a capacitor or a bolt – on type lead used during removal and temporary storage.

**Continuity Lead:** An approved lead or a standard lead supplied by the manufacturer which is used as a temporary means of maintaining continuity of the connections between other capacitors during the disconnection of a capacitor.

**Discharge Stick:** An approved device used for the purpose of discharging any residual charge in a capacitor / **Capacitor Bank**.

##### 13.4 Equipment Identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 13.5 Dangers

The main dangers to personnel are electric shock or burns arising from:

- The discharge of electrical energy retained by the static capacitors after they have been isolated.
- Inadequate precautions to guard against any induced voltages in the conductors or associated fittings.

### 13.6 Preparation of Work / Testing

- i) The capacitor bank must be isolated, points of isolation established and primary earths applied.
- ii) Shorting switches, where installed on the racks must be closed. The control of shorting switches is the responsibility of the Maintenance / Testing Engineer.
- iii) A Permit To Work or Permit To Test must be issued.

### 13.7 Work / Testing

- i) No capacitor **unit** must be **handled** unless it is short – circuited.
- ii) The Maintenance Engineer requesting the safety document must specify the position for application of clip - on short circuiting leads and continuity leads. Short circuiting leads and continuity leads must be applied to the appropriate capacitors under the personal supervision of the Maintenance / Testing Engineer.
- iii) Before the application of short circuiting leads to a capacitor provided with externally fuse, it must be discharged using the discharge stick under the personal supervision of the Maintenance / Testing Engineer.
- iv) Before an individual capacitor is removed from a rack,
  - a) The clip – on short circuiting lead must be replaced by a bolt – on short circuiting lead.
  - b) The bolt – on connection must be made before the clip - on lead is disconnected.
  - c) The continuity of the connections of adjacent capacitors must be maintained using the continuity leads.
  - d) During storage and transport, capacitors must be short -circuited using at least two complete turns, between terminals, of tinned copper fuse wire of not less than 30 amp. rating.
  - e) When work activity requires the opening or removal of shorting switches and specifies special requirements for subsequent access to capacitors, these actions must be carried out under the personal supervision of the Maintenance / Testing Engineer.



## CHAPTER -14

### RVPN SAFETY INSTRUCTIONS 10 (RSI - 10)

#### PRESSURE SYSTEMS

##### 14.1 Purpose

To protect all personnel against the dangers of pressurized systems.

##### 14.2 Scope

These RVPNL Safety Instructions apply the principles established by the Safety Rules to achieve safety from the system for personnel working on pressure systems.

##### 14.3 Definitions

- Pressure system:**
- a) A system comprising of one or more pressure vessels of rigid construction, any associated pipe work, protective devices and associated equipments.
  - b) The pipe work with its protective devices to which a portable gas container is, or is intended to be, connected.
  - c) A pipe line in its protective devices which contains or is liable to contain a relevant fluid/ gas at some pressure.
- Safe operating limit:** The operating limits (incorporating a suitable margin of safety) beyond which system failure is liable to occur.

##### 14.4 Equipment Identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 14.5 Dangers

The main dangers from pressure systems arise from:

- The uncontrolled release of pressurized substances, e.g., compressed air / gas / fluids, etc.

##### 14.6 Work / Testing

- i) When work is to be carried out on pressure systems, a competent person (Maintenance / Testing Engineer) must assess the means of achieving safety from the system. Work may be carried out under one of the following conditions:
  - a) With the system isolated and points of isolation established, pressure drained, air / gas / fluids vented and purged, and cooled, where necessary.

- b) With the system isolated and points of isolation established but containing pressurized substances, e.g., SF<sub>6</sub> gas / hydraulic oil in case of circuit breakers.
  - c) With the equipment operational.
  - d) With the equipment partly isolated and partly in its operational mode.
- ii) All equipment must be clearly demarcated according to RVPN Safety Instructions 02 (RSI – 02) while a safety document is in force.

#### **14.7 Work with the Equipment Isolated and Non Operational.**

- i) The equipment must be isolated from all external sources of energy and points of isolation established.
- ii) A non-return valve must not be considered as a shut off valve unless it is capable of being locked in the closed position.
- iii) Electrically and manually operated valves must be adjusted to the required position and locked. The electrical supply to electrically operated valves must be isolated or the mechanical drive disconnected.
- iv) Hydraulic and pneumatic control valves must be locked in the appropriate position.
- vi) The contents of the equipment must be adjusted to a safe level, which will avoid danger.
- vii) The equipment must be Vented and Purged as appropriate.
- viii) Pressure vessels must be regarded as confined spaces. When access is necessary the requirement of RVPN Safety Instructions 16 (RSI – 16) 'General Confined Spaces' must be applied.
- ix) A Permit To Work must be issued. Refer Safety Rule .4.5 (ii) (a).

#### **14.8 WORK / TESTING WITH THE EQUIPMENT IN AN OPERATIONAL OR PARTLY OPERATIONAL MODE**

- i) The following work can be carried out with the equipment in a fully operational or **partly** operational mode:
  - On-load repairs of leaks: On-load repair of leaks on compression joints (e.g., ermetto / threaded / flange joint etc.) may be carried out under the supervision of Maintenance / Testing Engineer.
- ii) If the work of testing requires the limited restoration of motive power (e.g., compressor motor electrical supplies), then the safety document issued will be a Permit To Work. Refer Safety Rule .44(i) (a).
- iii) The requirements and precautions for the restoration of those supplies will be as described in RVPN Safety Instructions 01 (RS –01).
- iv) The following activities may be carried out by the issue of a Permit To Test. Refer Safety Rule .4.3 (ii) (b).

- a) Testing of safety valves:  
The testing of safety valves or hydraulic testing must be carried out under the personal supervision of the Maintenance / Testing Engineer.
- b) Testing of pressurized air / gas / fluid:  
The testing of quality of compressed air / gas / fluid, pressurized system and testing equipments shall be carried out under the personal supervision of a Maintenance / Testing Engineer.

#### **14.9 Inspection and Hydraulic Testing**

A hydraulic test at a pressure in excess of the safe operating limit is an over pressure test. Such a test must only be done in accordance with a written procedure approved by the Sub Station - In - Charge and with the issue of a Permit To Test.

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## CHAPTER -15

### RVPN SAFETY INSTRUCTIONS 11 (RSI - 11)

#### STATION STORAGE BATTERY

##### 15.1 Purpose

To specify procedures needed to achieve safety from inherent dangers when testing / maintenance is being carried out on station storage batteries.

##### 15.2 Scope

These RVPN Safety instructions apply the principles established by the Safety Rules to achieve safety from the system for personnel working on station storage batteries.

##### 15.3 Definitions

**A battery bank:** All battery cells, connections and stands comprise a battery bank.

##### 15.4 Equipment Identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 15.5 Dangers

The main dangers to personnel working on a battery bank are electric shock or burns arising from:

- The possibility of personnel inadvertently shorting battery terminals.
- Dangers spilling of electrolyte on body.
- Asphyxiation or suffocation due to the fumes of storage battery acid.

##### 15.6 General requirements

- i) The Sub Station – In – Charge must carry out an assessment to determine the conditions under which the work is to take place and if a safety document is required to be issued.
- ii) When work is to be carried out on a battery bank, adequate precautions must be taken to achieve safety from the danger of DC voltage and spilling of electrolyte.
- iii) When work on live equipment requires portable instruments to be used for impedance or voltage measurements, the instruments must be provided with insulated probes.
- iv) When handling acid, extreme care must be taken and personnel protective equipment like face shield, apron, gloves, etc. must be used before work is undertaken.

- v) Proper ventilation alongwith water supply in washbasin shall be ensured in or near the battery room.
- vi) While preparing electrolyte, always **ADD ACID TO WATER. NEVER ADD WATER TO ACID.**
- vii) Always clean spilled acid immediately.
- viii) During handling of acid, sufficient quantity of water must be available nearby.

#### **15.7 Working / Testing on Station Battery Bank.**

- i) Wherever required, points of isolation must be established. Any fuses and links and / or safety keys used to secure the points of isolation must be retained in key safe.
  - ii) Sub Station – In – Charge must assess the work required to be done on a battery bank and decide whether it must be carried out under:
    - a) Permit To Work, and/or
    - b) Personal supervision.
  - iii) The work must be carried out by competent person(s).
  - iv) The competent person(s) who shall do the work must first remove all metallic objects such as wrist watch, rings, wristlets, cufflinks, pendants, etc. on their person.
  - v) Where necessary to prevent injury, approved insulated tools, insulating stands, mats, gloves, apron, face shields, as appropriate, must be used.
  - vi) Only suitable testing instruments with insulated test probes must be used.
  - vii) Consideration must be given to a competent person being accompanied by another competent person if the presence of such a person could contribute significantly to ensuring that injury is prevented. Any accompanying competent person must be trained to recognize danger and if necessary to render assistance in the event of an emergency, e.g., accidental spilling of acid on eyes, unconsciousness due to inhalation of toxic gases, etc.
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## CHAPTER -16

### RVPN SAFETY INSTRUCTIONS 12 (RSI - 12)

#### FIRE PROTECTION AREAS

##### 16.1 Purpose

To ensure safety of personnel from the effects of fixed automatic fire protection / fighting systems

##### 16.2 Scope

These RVPN Safety Instructions apply the principles established by the Safety Rules to achieve safety from the system for personnel working in, or entering areas protected by fixed fire protection / fighting systems.

##### 16.3 Equipment Identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 16.4 Dangers

The main dangers to personnel from the operation of fixed fire protection / fighting systems are:

- Asphyxiation / suffocation as a result of operation of fixed fire fighting systems.
- Falling or striking against objects due to poor visibility after the release of contents of fire extinguishers.

##### 16.5 PRESSURIZED SYSTEMS (HYDRANT / HIGH VELOCITY WATER SPRAY SYSTEMS)

- i) Before work commences in an area protected by a water emulsifier fire protection system, the system must be isolated.
- ii) The following precautions must be taken:
  - a) The automatic control of the fire protection system must be rendered inoperative and the control kept on 'Manual'. Valves should be closed for the particular equipment for which PTW / PTT is being issued in order to isolate it from the rest of the system. These actions must be recorded in accordance with RVPNL Safety Instructions 01 (RSI - 01), 03 (RSI - 03) and 10 (RSI - 10).
  - b) Notice(s) indicating that the control is on 'Manual' must be fixed to the automatic / manual selector switch and at point(s) of access to the area.
  - c) Precautions taken to render the automatic control inoperative must be noted on any Permit To Work/ Permit To Test issued for work / testing in the protected area.
- ii) Automatic control of the fire protection system can be restored after all persons have withdrawn from the area / all access doors have been locked.

## **16.6 Access to Areas Following Operation of Fire Protection Systems**

Before persons are permitted to enter an area into which a fire protection system has been discharged, whether following a fire or accidentally, the area must be thoroughly checked and verified as safe by the Shift - In - Charge. If the atmosphere cannot be verified as safe and it is essential to enter the area, approved breathing equipment and protective apparel must be worn.

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## CHAPTER -17

### RVPN SAFETY INSTRUCTIONS 13 (RSI - 13)

#### PROCEDURE FOR WORKING ON SF<sub>6</sub> GAS FILLED EQUIPMENT

##### 17.1 Purpose

To protect all personnel against inherent hazards / dangers while working on SF<sub>6</sub> gas filled equipments.

##### 17.2 Scope

These RVPN Safety Instructions lay down procedures for working on SF<sub>6</sub> gas filled equipments and to protect all personnel against inherent dangers / hazards of SF<sub>6</sub> gas.

##### 17.3 Definitions

**Impurities:** Impurities (toxic or non toxic) contained in SF<sub>6</sub> gas filled in EHV equipments.

**Decomposition products:** Electrical discharge decomposes SF<sub>6</sub> gas into SF<sub>4</sub>, SF<sub>2</sub>, etc. These are called decomposition products. In some cases, sulphur fluoride gas is also formed due to electric discharges.

##### 17.4 Equipment Identification

Equipment on which work is to be carried out must be readily identifiable. Wherever necessary, a means of identification must be fixed to it which will remain effective throughout the duration of work.

##### 17.5 Dangers

Following are the dangers which the personnel may be subjected to while working on SF<sub>6</sub> gas filled equipments:

- Since SF<sub>6</sub> gas is heavier than air, there is danger of asphyxiation (suffocation) in the storage / work area in the absence of proper ventilation.
- Decomposition products, e.g., sulphur fluorides and other toxic gases having pungent or unpleasant odour may cause irritation in nose, mouth and eyes.

##### 17.6 Working Procedures

- i) A Permit To Work must be issued before starting the work.
- i) The equipment **on which work is to be done** must be electrically isolated from other equipments.
- ii) The equipment must be earthed at two points.
- iii) Using gas evacuation trolley, SF<sub>6</sub> gas should be taken out from the equipment and evacuation upto about 50 mbar should be achieved.



- iv) After ensuring that total gas has been evacuated / removed, then only the equipment should be opened / dismantled.
  - v) In general, a mask or other protective measures are not necessary when no appreciable amount of dust (fluoride powder) or odour exists. However, during internal inspection of the interior path of apparatus, personnel should take precautions to avoid exposure to the break down products and suitable protective equipment like gas mask (preferably incorporating molecular filter, etc.), industrial type goggles (SF<sub>6</sub> gas dust can some times attack the glass of goggles, spectacles, etc.) and rubber gloves shall be used.
  - vi) After completing the work on the equipment, the equipment should be reassembled.
  - vii) Before refilling SF<sub>6</sub> gas, evacuation upto 5 m bar should be carried out for about two hours. Thereafter, SF<sub>6</sub> gas should be filled in the equipment.
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## CHAPTER -18

### RVPN SAFETY INSTRUCTIONS 14 (RSI - 14)

#### AUTHORISATION (WORK ALLOCATION) OF PERSONS

##### 18.1 Purpose

To define guidelines for **authorising** persons for carrying out maintenance works in EHV Sub Stations or on transmission lines.

##### 18.2 Scope

These RVPN Safety Instructions set down procedures for **authorisation** of personnel such as Maintenance Engineer, Testing Engineer, Shift - In - Charge, Sub Station - In - Charge, Line - In - Charge, Operator and Authorized Person.

##### 18.3 Definitions

<b>Maintenance Engineer:</b>	Engineer responsible for carrying out maintenance works of EHV equipments, transmission lines and HV / MV / LT systems.
<b>Testing Engineer:</b>	Engineer responsible for carrying testing of protective relays & systems, PLCC panels and other related equipments
<b>Shift - In - Charge:</b>	Engineer responsible for all operations / activities in Sub Stations.
<b>Sub Station - In - Charge:</b>	Engineer responsible for all operation and maintenance activities being done / to be done in the Sub Station.
<b>Line - In - Charge:</b>	Engineer responsible for patrolling of and maintenance activities being done or to be done on the transmission line.
<b>Lead Shift - In Charge:</b>	Shift - In - Charge of the Sub Station where PTW /PTT has been applied for and who shall be responsible for coordination of operation activities involved for carrying out line maintenance.
<b>Operator:</b>	Person authorized to carry out operations of EHV equipment or to use specific type of vehicles or cranes within Sub Station.
<b>Authorized Person(s):</b>	Person(s) authorized to carry out operation / maintenance work on EHV equipments / transmission lines.

##### 18.4 Procedures

- i) Only **authorised** persons shall be allowed to carry out operation and maintenance activities in Sub Stations / on transmission lines.
- ii) Safety guidelines during O&M of Sub Stations shall be issued by Sub Station - In - Charge. All operation and maintenance activities shall be carried out under the control of Sub Station - In - Charge.

- iii) For carrying out maintenance work, issue of safety document (PTW / PTT) shall be approved by Sub Station - In - Charge.
  - iv) Sub Station - In - Charge shall **authorise** Shift - In - Charge & Maintenance Engineer for carrying out O&M activities. Maintenance Engineer shall also be Testing Engineer for local testing. Engineers of the Protection Wing & other fields who have been assigned specific testing tasks shall also be designated as Testing Engineers. Sub Station safety documents, i.e., PTW / PTT shall be filled by Maintenance Engineer / Testing Engineer for carrying out maintenance / testing activities in Sub Stations. PTW / PTT are to be approved by Sub Station - In - Charge before being issued by Shift - In - Charge.
  - v) All operations including isolation and earthing of equipments shall be carried out by the Operator in the presence of Shift - In - Charge.
  - vi) Only after personally confirming isolation and earthing in the work area, the Shift - In - Charge shall issue the PTW / PTT. After receipt of PTW / PTT, the Maintenance Engineer / Testing Engineer shall advise the Authorized Persons for carrying out maintenance / testing activities. All Authorized Persons shall be **selected** by Maintenance Engineer / Testing Engineer.
  - vii) Maintenance Engineer / Testing Engineer shall be responsible for taking all safety precautions during maintenance testing works including use of Personnel Protective Equipment (PPEs).
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## CHAPTER -19

### RVPN SAFETY INSTRUCTIONS 15 (RSI - 15)

#### PROCEDURE FOR ADDING TO / REMOVING FROM THE EHV / HV SYSTEM

##### 19.1 Purpose

To define procedure for safely adding / removing equipments (new / old) to / from the EHV / HV system.

##### 19.2 Scope

These RVPN Safety Instructions define procedures to achieve safety of personnel and / or transmission system safety while adding / removing equipments to / from the EHV system.

##### 19.3 Definitions

**Bay:** An array of switching and protective equipments (such as circuit breaker, current transformer, isolators, wave trap, control and relays panels, etc.) for control and protection of a feeder, i.e., transmission line or transformer / reactor, etc. which are to be commissioned or added to / removed from the transmission system.

**Bay equipment:** Circuit breaker, current transformer, wave trap, control and relay panels, etc. which are part of the bay.

**Inter Linking Transformer (ILT):** Transformer used to step up / step down the system voltage and are synchronized with the system on both the HV and LV sides

**Reactor:** Line or bus reactor used for controlling the system voltage.

**Maintenance Engineer:** Engineer responsible for carrying out maintenance works of EHV equipments, transmission lines and HV/ MV / LT systems.

**Erection Engineer:** Engineer responsible for all erection activities related to addition/removal of equipment to / from the bay.

**Sub Station - In - Charge:** Engineer responsible for erection, operation and maintenance activities being done / to be done in the Sub Station.

##### 19.4 Procedures

###### i) Adding Complete Bay to EHV / HV System.

- a) When a new bay is to be added to existing EHV / HV system, safety precautions as per RSI - 08, including maintaining safe electrical clearance, need to be taken during movement of crane for carrying out erection / dismantling work.

- b) Before connecting the new equipment, pre-commissioning checks are to be completed first.
- c) Once pre-commissioning checks are completed, necessary PTW / PTT is to be requested by Erection Engineer which shall be approved by Sub Station - In - Charge. Work of connecting jumpers, etc. is to be completed taking safety precautions as per RSI - 01. After connecting to the existing EHV system, all commissioning checks are to be performed.
- d) All control cables & protection relays are to be connected while taking all safety precautions.

**ii) Adding Bay Equipment to EHV / HV System**

- a) When old bay equipment is to be replaced by new type/ design of equipment, then work shall be carried out only after issue of safety documents, i.e., PTW / PTT duly approved by Sub Station - In - Charge and taking safety precautions as per RSI - 01.

**iii) Removing complete Bay from EHV / HV System**

- a) When any bay is to be removed from EHV / HV system, then PTW / PTT is to be issued which shall be approved by Sub Station - In - Charge. Safety precautions as per RSI - 01 are to be taken during dismantling work.
- b) The bay which is to be removed shall be identified / isolated from the rest of the system.
- c) Safety precautions as per RSI – 08, including maintaining safe electrical clearance, need to be taken during movement of crane for carrying out dismantling work.

**iv) Removing Bay Equipment from EHV / HV System**

- a) When any bay equipment is to be removed from EHV / HV system, then PTW / PTT is to be issued which shall be approved by Sub Station - In - Charge. Safety precautions as per RSI - 01 are to be taken during dismantling work.
- b) Bay Equipment which is to be removed shall be identified/ isolated from the rest of the system.
- c) Safety precautions as per RSI – 08, including maintaining safe electrical clearance, need to be taken during movement of crane for carrying out dismantling work.

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## CHAPTER -20

### RVPN SAFETY INSTRUCTIONS 16 (RSI - 16)

#### PROCEDURE FOR WORK IN GENERAL CONFINED SPACES

##### 20.1 Purpose

To define procedures for precautions to be taken to prevent Danger when entry into a confined space is required.

##### 20.2 Scope

These RVPN Safety Instructions define procedures to achieve safety of personnel when it is necessary to enter a confined space either for inspection or work.

##### 20.3 Definitions

Confined space is one of the following:

- i) A normally sealed tank for which entry is **through** a manhole or inspection window or similar point of access, e.g., as in transformer tank, shunt reactor tank, GIS, etc.
- ii) Open topped pits, sumps or trenches which may contain dangerous substances **or reptiles**.
- iii) Inverted bottom spaces which may contain dangerous substances **or reptiles**.
- iv) Rooms, buildings or other enclosures which contain gases that have displaced air.

##### 20.4 Dangers

- i) The main Dangers to personnel in confined spaces are:
  - a) Asphyxiation or suffocation.
  - b) Poisoning due to toxic atmosphere / **biting by reptiles**.
  - c) Fire causing an explosion or burns to personnel.
  - d) Effect of excessive noise.
  - e) Falling or getting trapped within the confined space.
- ii) Danger in confined spaces can also be caused by work such as application of heat to the surface which may cause ignition of the contents or cause a chemical reaction between the contents or the residue.
- iii) Danger in confined spaces can also be present in open topped pits, sumps or trenches which may contain trapped gases which are heavier than air, e.g., SF<sub>6</sub>, LPG, Chlorine or sump solvents. Similarly, inverted open bottom spaces may contain gases which are lighter than air, e.g., Hydrogen.

- iv) Danger in confined spaces can also be due to gases which have density similar to air, e.g., Nitrogen and CO<sub>2</sub>, but which displace air.

## 20.5 Procedures

### i) **CONFINED SPACES WHICH HAVE NOT CONTAINED TOXIC OR ASPHYXIATING / SUFFOCATING AIR OR FLAMMABLE SUBSTANCES.**

- a) In case of EHV / HV / MV / LV equipment and **wherever** considered necessary in other cases, a Permit To Work shall be issued specifying the precautions to be taken to achieve safety and any additional precautions to be taken during the duration of the work.
- b) Before any work is commenced, all supplies of gases, liquids, etc. must be isolated and the confined space vented to atmosphere.
- c) Maintenance Engineer shall give consideration to the provision of forced ventilation within the confined space for the duration of the work.
- d) Oxygen should not be used to “sweeten” the atmosphere in the confined space. Oxygen enriched atmosphere can make substances such as grease liable to spontaneous combustion.
- e) If it is essential to use gas or electrical welding equipment inside the confined space, additional precautions must be taken to eliminate Danger from the heat or flame or electrical sparks and / or gases caused by such operations.
- f) If entry to or access within the confined space is restricted or there is possibility of slipping or falling within the confined space, provision must be made to safely evacuate any personnel who are overcome by fumes or are injured. The provision of a suitable harness (safety belt) with ropes and staff stationed outside the confined space shall be provided.

### ii) **CONFINED SPACES WHICH HAVE CONTAINED TOXIC OR ASPHYXIATING / SUFFOCATING AIR OR FLAMMABLE SUBSTANCES.**

- a) In case of EHV / HV / MV / LV equipment and where considered necessary in other cases, a Permit To Work shall be issued specifying the precautions to be taken to achieve safety and any additional precautions to be taken during the duration of the work.
- b) Before any work is commenced, all supplies of gases, liquids, etc. must be isolated and the confined space vented to atmosphere.
- c) A suitably qualified person, e.g., a Chemical Engineer should be consulted and requested to test the atmosphere to ensure that no toxic, asphyxiating / suffocating or flammable substances are present within the confined space and that there is a sufficient quantity of air to support life.
- d) The suitably qualified person should specify at what regular intervals such tests as at .20.5 (ii) (c) above should be repeated for the duration of the work.
- e) The provisions of 20.5 (i) (c) to 20.5 (i) (f) shall be followed.
- f) If it is not possible to exclude all the Dangers, then breathing apparatus must be used by all persons entering the confined space. Only staff

trained to use such apparatus shall be permitted to enter the confined space.

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## CHAPTER -21

### RVPN SAFETY INSTRUCTIONS 17 (RSI - 17)

#### PROCEDURE FOR WORK INSIDE TRANSFORMER / REACTOR TANKS

##### 21.1 Purpose

To define procedures for precautions to be taken to prevent Danger when entry into the tank of a transformer / reactor is required.

##### 21.2 Scope

These RVPN Safety Instructions define procedures to achieve safety of personnel when it is necessary to enter the tank of a transformer / reactor for the purpose of internal inspection or for erection.

##### 21.3 Dangers

- i) The main Dangers to personnel inside the tank of a transformer / reactor are:
  - a) Asphyxiation or suffocation.
  - b) Fire causing an explosion or burns to personnel.
  - c) Falling or getting trapped within the tank of a transformer / reactor.
- ii) Danger inside the tank of a transformer / reactor can also be caused by work such as application of heat to the surface which may cause ignition of the oil vapors present in the tank.
- iii) Danger inside the tank of a transformer / reactor can also be present in inverted open bottom spaces which may contain gases which are lighter than air, e.g., Hydrogen.
- iv) Danger inside the tank of a transformer / reactor can also be due to gases which have density similar to air, e.g., Nitrogen and CO<sub>2</sub>, but which displace air.

##### 21.4 Procedures

- i) A Permit To Work shall be issued specifying the precautions to be taken to achieve safety and any additional precautions to be taken during the duration of the work.
- ii) Before any work is commenced, all possible inspection windows and man holes shall be opened and the tank of the transformer / reactor vented to atmosphere.
- iii) Maintenance Engineer shall give consideration to the provision of forced ventilation (and injection of dry air where required for limiting effect of moisture on winding insulation) within the tank of the transformer / reactor for the duration of the work.

- iv) Oxygen should not be used to “sweeten” the atmosphere in the tank of the transformer / reactor. Oxygen enriched atmosphere can make substances such as grease liable to spontaneous combustion.
  - v) If it is essential to use gas or electrical welding equipment inside the tank of the transformer / reactor, additional precautions must be taken to eliminate Danger from the heat or flame or electrical sparks and / or gases caused by such operations.
  - vi) If entry to or access within the tank of the transformer / reactor is restricted or there is possibility of slipping or falling within the tank of the transformer / reactor, provision must be made to safely evacuate any personnel who are overcome by fumes or are injured. The provision of a suitable harness (safety belt) with ropes and staff stationed outside the tank of the transformer / reactor shall be provided.
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