

# IMPORTANCE OF INTERLOCKS IN MV VCB SWITCHGEARS

## RESCUER OF HUMAN LIFE

K N. SHIKARVAR, NIKUNJ K. CHAUHAN,  
<sup>1</sup>SENIOR MANAGER, <sup>2</sup>ENGINEER,  
 CUSTOMER CARE DEPARTMENT,  
 STELMEC LIMITED, AHMEDABAD, GUJARAT, INDIA

**Abstract :** *The Knowledge of Medium Voltage Switchgear Interlock acquired by engineers can be extended to solve crucial issue on perspective of human safety. To prevent any kind of accidents/ incident during operation & Maintenance of MV VCB switchgear, the interlocks are given to protect the human life as well as the equipment also. The purpose of this paper is to identify safety related precaution in MV VCB Switchgears, and the solution strategy employed in solving the problems by using different types of interlocks. This paper also gives the brief knowledge of the interlocks provided in to the MV VCB Switchgears panel and how they work and its merits to the customers and it also discusses in the areas of Interlocks, Safety for more reliable, customer friendly & safe and secure operation of MV VCB Switchgear to reduce the accidents.*

**Index Terms -** Safety, MV Switchgears, Failures, Merits of Interlocks, Protection

### I. INTRODUCTION

In MV Switchgear mal-operations in electrical installations may expose operating personnel to danger and lead to electrical accident. As a measure of protection against incorrect sequences of operations by operating personnel, mechanical and electrical **Interlocks** are included in the mechanisms and in control circuits of electrical apparatus.

There are such a numbers of interlocks are provided into the MV VCB Switchgear panel for the safety of the human personnel. The operating personnel have to keep safety while doing the operation of switchgear and the operating person should not By-pass any kind of interlocks. Because By-pass provision itself leads to accident

### II. NEED OF INTERLOCKS IN MV SWITCHGEAR

As per survey, Majority of accidents (Fatal/ Non-fatal) occurred due to defeat or By-pass of standard operation sequence of MV switchgear panels. Sometime operating staff may not follow the sequence of standard practice due to casual approach, over confidence, emergency of restoring of power etc reason, which leads to accident.

Hence, Introduce Interlocks (Mechanical & Electrical) in MV switchgear panel, such a way, that prevent override or by-pass correct sequence of operation. Hence eliminate the possibility of any accident & rescue of human life.

#### 1. Definition of Interlock:

- It is a Mechanical &/or Electrical arrangements provided in MV Switchgear mechanisms & its control circuits to prevents incorrect sequences of operations by operating personnel.

#### 2. Benefit to customer due to Interlocks:

- It prevent major breakdown hence require less time to restore the power.
- Save life of panel operating personnel
- Save cost of repairing of equipment
- Extend life of equipments

#### 3. Benefit to society :

- Major Injury can be avoid due to interlock
- Less possibility of flash over/ Heavy electrical Hazard
- Un-interrupted power due to less/ eliminate failure of electrical equipment (MV switchgear & panel)

### III. 11 KV MV SWITCHGEAR INTERLOCK DISCRIPTION:

#### (I) Interlock 1:-

The circuit breaker cannot be withdrawn from “SERVICE” position To “TEST” position unless it is in “OFF/ OPEN” condition.

#### Working principle of Interlock:-

A latching lever (mechanical arrangement of MS Strip) is obstructed the access of rack in-rack out mechanism, When the VCB is in ON/ CLOSE condition.

In breaker “OFF/ OPEN” condition, a latching lever is allow to access Rack in-out mechanism, hence operator can withdraw the breaker. Hence operating person cannot withdraw breaker from service position in “ON/ CLOSE” condition unless breaker is “OFF/ OPEN”.

**Advantage/Merit of Interlock:-**

If breaker is rack out from "SERVICE" position to "TEST" position in "ON/ CLOSE" condition then major accident occurred due to separation of main contact without any medium of arc extinguisher (i.e. Vacuum, oil, SF6 gas, Arc chute)

This interlock prevents accidents during Rack in-out of breaker. As per survey, major Fatal/Nonfatal accident occurred during rack in-out process. This interlock is eliminates such a possibility.

**(II) Interlock 2:-**

The circuit breaker can be closed only in 'TEST' and in 'SERVICE' position. In intermediate position breaker operation is not possible Mechanically as well as Electrically also.

**Working principle of Interlock:-**

There are mainly three positions of Breaker in MV switchgears panel:

- 1) SERVICE Position: In this position, Breaker is engaged with Main (Live) bus-bar through arm & jaw contact.
- 2) INTERMEDIATE Position: In this position, Breaker is separate from Main (Live) bus-bars but still not reached "TEST/SAFE" Position
- 3) TEST Position: In this position, Breaker is reaching its "SAFE" condition & person can do maintenance work.

A latching lever (Mechanical) is obstructed the breaker mechanism movement & Micro switch cut supply of closing coil during intermediate position, hence breaker cannot "ON/ CLOSE" unless "SERVICE & TEST" position.

**Advantage/Merit of Interlock:-**

- If Operator may not properly insert breaker in "SERVICE" position & "ON/CLOSE" breaker then a chance of flash over (an unintended electric discharge)
- Breaker may "ON/CLOSE" in Intermediate position due to mal operation of mechanism or Operating staff, which is unsafe.
- This interlock eliminates both above phenomenon & rescue life of operators.

**(III) Interlock 3:-**

It shall not be possible to open the panel front door while circuit breaker is in service position.

**Working principle of Interlock:-**

When the breaker is in SERVICE position, a latching lever is engaged with panel front door until breaker is in "TEST" position.

**Advantage/Merit of Interlock:-**

If any fault occurred during breaker is in SERVICE, Arc/ flash may come outside of panel & may injured operating personnel, who is standing in-front of it. This interlock is eliminates such a possibility.

**(IV) Interlock 4:-**

Circuit breaker cannot be racked-in unless the control plug is inserted.

**Working principle of Interlock:-**

A latching lever obstructs movement of breaker if control plug (Aux supply for trip & closing coil, indication etc) is not connected with breaker.

**Advantage/Merit of Interlock:-**

If operator forgot to engage control plug with socket, then breaker does not operate on faulty condition, which may lead to serious accident. This interlock is eliminates such a possibility.

**(V) Interlock 5:-**

If breaker is in SERVICE condition and unintentionally panel front door opens than the designated breaker will going to be tripped automatically.

**Working principle of Interlock:-**

If someone try to open Panel front door then latching lever release trip command.

**Advantage/Merit of Interlock:-**

In open door condition, if any fault occurred in breaker, then it may chance of arc/ flash may come outside of panel & may injured operating personnel, who is standing in-front of it. This interlock is eliminates such a possibility.

**(VI) Interlock 6:-**

When rear cover of cable compartment is opened the breaker shall open instantly & also the breaker shall get trip command instantly.

**Working principle of Interlock:-**

A limit switch is provided on rear side of panel, when rear door is open then NO contact of limit switch become NC & Trip command goes to breaker & instantly breaker is OFF/ OPEN. The breaker could not ON until the rear cover is OPEN.

**Advantage/Merit of Interlock:-**

Power cable connected at back side of panel. While opening of rear cover, HT cable / Live part may exposes / access. This is very dangerous if cable is in live condition due to any reason. This Interlock is eliminates such a possibility.

**(VII) Interlock 7:-**

- 1) Circuit breaker cannot be withdrawn from the 'SERVICE' position, If any one of cable side live line indicator is 'ON'.
- 2) Incomer panel circuit breaker cannot be withdrawn from the 'SERVICE' position, if the HV side breaker is in 'ON' position.
- 3) PT cannot be withdrawn from the 'SERVICE' position, if the HV side breaker and incomer circuit breaker is on.

**Working principle of Interlock:-**

This SOLENOID COIL interlock is given for the purpose that nobody can rack out the breaker from service position when it is ON.

When the breaker is in ON condition and all cable side live line indications are ON at that time this Solenoid coil interlock will not give access to rack out the breaker. When the breaker is in OFF condition and all cable side indication are OFF at that time only solenoid coil give access to rack out the breaker from service position. This interlock is provided for the breaker as well for the Potential Transformer i.e. P.T also into INCOMER panel.

**Advantage/Merit of Interlock:-**

When Power is ON due to any defect of breaker (i.e. VI defect / Back Power / Mechanism failure / One phase live condition etc.) It may lead to an accident if VCB is Racked-Out from "SERVICE" to "TEST" position. This interlock is eliminates such a possibility.

**(VIII) Interlock 8:-**

When top pressure relief flap of any panel will become open, than Incomer or upstream breaker going to 'TRIPPED' and trigger an 'ALARM'.

**Working principle of Interlock:-**

A limit switch is fitted with pressure relief flap of panel, when pressure relief flap operate then NO contact of limit switch become NC & Trip command goes to Incomer or upstream breaker & instantly breaker is OFF/ OPEN.

**Advantage/Merit of Interlock:-**

During Bus-bar fault or Internal fault in MV Switchgear the particular VCB protection may not performed its trip operation. In this case up-stream VCB should cut-off power to prevent / extend further fault.

**(IX) Interlock 9:-**

Interchangeability of breaker with other rating panel is not possible.

**Working principle of Interlock:-**

A lever is provided with each of particular rating panel which is allow only similar rating of breaker. It is obstacle for rack in of other rating breaker.

**Advantage/Merit of Interlock:-**

During shutdown in a sub-station, all breakers rack out from the panel & it may chance of interchange of lower rating breaker (outgoing/ feeder breaker) with the higher rating breaker (Incommer/ bus coupler breaker). This may cause an electrical hazard due to improper contact with live part. This interlock is eliminates such a possibility.

**(X) Interlock 10:-**

Safety shutters will automatically close to cover the fixed contact bushing spout when the breaker is racked-out from its SERVICE position.

**Working principle of Interlock:-**

A latching lever is connected with Safety shutters (i.e. Busbar side & cable side) & its operate mechanically during rack in- rack out operation of breaker.

**Advantage/Merit of Interlock:-**

It may chances of the accidently touching live parts of bus-bar / Cable side when breaker is racked out from the breaker Chamber. This interlock is eliminates such a situation.

**IV. CONCLUSION:-**

Today Vacuum Circuit Breakers are mostly accepted and used in MV Switchgears in the electrical field. Interlocks are provided for the safety and security of operating staff and also of the system. The person who is interacting with MV Switchgears should not By-Pass any electrical & mechanical interlocks of panel.

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**V. ACKNOWLEDGMENT**

STELMEC Limited – a leading manufacturer of medium & Low voltage Switchgear Products catering to various Electricity Boards/ Utilities & Industries. Stelmec manufacturers wide range of products comprising 11 KV & 33 KV Indoor Vacuum Circuit Breaker Panels, Outdoor Porcelain Clad Vacuum Circuit Breakers, Outdoor Vacuum Circuit Breaker Kiosks, Control & Relay Panels (6.6 KV to 220 KV) etc.

STELMEC Limited has vast experience of VCBs manufacturing, operation, design, Interlock and safety. The company is continuously improving the design of MV Switchgears VCB to provide better and secure operation of VCB and also safety of the operating person.

We are very much grateful to the STELMEC LTD. management for kind support, guidance and granting permission to publish this paper.

#### BIOGRAPHY:-



KALPESH N. SHIKARVAR has received his degree in Electrical Engineering from Govt Engineering college, Gandhinagar in June-2000. He also possess degree of Post Graduate Diploma Operation Management (PGDOM) from IGNOU & Member of The Institute of Engineers (India).

He is currently working as a Senior Manager in Customer Care Dept, STELMEC Limited, Ahmedabad. He has 16 years experience of Medium Voltage switchgear.



NIKUNJ K. CHAUHAN has received his M.E degree in Electrical Engineering with Specialization in Power System Engineering from Birla Vishvakarma Vidyalaya Engg. College, V.V. Nagar from Gujarat Technological University, Ahmedabad, India.

He has done B.E in Electrical Engineering from Govt. Engg. College, Dahod.

He is currently Working as an Engineer in Customer Care Dept., STELMEC Ltd., Ahmedabad.

His research interests are power system protection as well as power system operation and optimization methods.

