# CHAPTER 8 – PART B

# Auxiliary Network (Underground)

**Table of Contents**

# 1. 33KV GIS CRICUIT BREAKER

## 1.1 MVCB (FOR TRANSFORMER PROTECTION)

| Sr. No. | INDICATIONS | U | Values Required |
|---|---|---|---|
| **1** | Manufacturer | | |
| 2 | Place of manufacture | | |
| 3 | Standards | | IEC 60694, 62271-100, 62271-102, 62271-200 |
| **A** | **CUBICLE** | | |
| 1 | - Class | | Indoor |
| 2 | - Rated insulation voltage | kV | 36 |
| 3 | - Rated operating voltage | kV | 33 |
| 4 | - Rated frequency | Hz | 50 |
| 5 | - Rated short time duration power frequency withstand voltage | kV r.m.s. | 70 |
| 6 | - Rated lightning impulse withstand voltage | kV peak | 170 |
| 7 | - Cubicle rated current | A | 1250 |
| 8 | - Bar set rated current | A | 1250 |
| 9 | - Allowable overcurrent for 1 second | kA r.m.s. | 25 |
| 10 | - Instantaneous overcurrent | kA peak | 62.5 |
| 11 | - Number of flip-flop contacts for circuit-breaker plugging-in and plugging-out monitoring | minimum | |
| 12 | - Number of flip-flop contact for earthing isolator open/closed position monitoring | minimum | |
| 13 | - Number of flip-flop contacts for isolator open/closed position monitoring | minimum | |

| Sr. No. | INDICATIONS | U | Values Required |
|---|---|---|---|
| 14 | - Approximate dimensions of the cubicle<br>- Width<br>- Depth<br>- Height<br>- Depth with circuit-breaker plugged-out | <br>mm<br>mm<br>mm<br>mm | <br>600<br>1330<br>2400 |
| 15 | - Protection degree | | IP65 for HV,<br>IP 3X for LV |
| 16 | - Earthing isolator making capacity | kA | |
| 17 | - Overall dimension drawing number | | |

| | INDICATIONS | U | Values Required |
|---|---|---|---|
| | **2) CIRCUIT-BREAKER/ INTERRUPTER (Vacuum Type)** | | |
| | Three pole type | | |
| 1 | - Rated insulation voltage | kV | 36 |
| 2 | - Rated operating voltage | kV | 33 |
| 3 | - Rated frequency | Hz | 50 |
| 4 | - Rated short time duration power frequency withstand voltage | kV r.m.s. | 70 |
| 5 | - Rated lightning impulse withstand voltage | kV peak | 170 |
| 6 | - Rated short time duration power frequency withstand voltage across isolating distance @ | kV r.m.s. | |
| 7 | - Rated lightning impulse withstand voltage across isolating distance @ | kV peak | |

| | | | |
|---|---|---|---|
| 8 | - Rated current | A | 630 |
| 9 | - Allowable overcurrent for 1 second | kA r.m.s. | 25 |
| 10 | - Instantaneous overcurrent | kA peak | 62.5 |
| 11 | - Breaking capacity | kA r.m.s | 25 |
| 12 | - Making capacity | kA peak | 62.5 |
| 13 | - Breaking mode: | | |
| 14 | - Opening time | ms | ≤70 |
| 15 | - Breaking time | ms | ≤80 |
| 16 | - Closing time | ms | ≤100 |
| 17 | - Rated operating cycle | | O-0.3s-CO-3 min-CO |
| 18 | - Breaking capacity of cable at no load | A | |
| 19 | - Number of auxiliary contact for open/closed position of the circuit-breaker | O/O<br>O/C | |
| 20 | - Auxiliary supply voltage | V dc | 110 |
| 21 | Supply voltage for motor drive circuits | V dc | 110 |
| 22 | - Allowable variation range of supply voltage | | +10%, -15% |
| 23 | - Power consumption of auxiliary | VA | |
| 24 | - Coils consumption:<br>- engagement coil<br>- release coil | <br>A<br>A | |
| 25 | - Consumption of arming motor | A | |
| 26 | - Maximum noise level during opening and closing actuation | dB | |
| 27 | Degree of protection for auxiliary circuit | | IP3X |

## 1.2 33kV GIS CIRCUIT BREAKER (for Ring Main Feeder)

| Sr. No. | Particulars | Unit | Technical Particulars |
|---|---|---|---|
| **A** | **Switchgear Panel** | | |
| 1. | Standard | | IEC 60694, 62271-100, 62271-102, 62271-200 |
| 2. | Class | | Indoor |
| 3. | Type | | GIS |
| 4. | Nominal system Voltage | KV | 33 |
| 5. | Highest System Voltage | KV | 36 |
| 6. | Frequency | Hz | 50 |
| 7. | Nominal Current Rating | A | 1250 |
| 8. | One Minute Power frequency withstand Voltage | kV (rms) | 70 |
| 9. | 1.2/50 microsecond Impulse withstand Voltage | kV (peak) | 170 |
| 10. | Rated short time duration power frequency withstand voltage across isolating distance @ | kV r.m.s. | |
| 11. | Rated lighting impulse withstand voltage across isolating distance @ | kV Peak | |
| 12. | Symmetrical breaking capacity | kA | 25 |
| 13. | Making Capacity | kA | 62.5 |
| 14. | Short time current for 1 sec | kA | 25 |
| 15. | Degree of Protection | | IP-65 for HV, IP-3X for LV |

| | | | |
|---|---|---|---|
| 16. | - Approximate dimensions of the cubicle<br>- Width<br>- Depth<br>- Height<br>- Depth with circuit-breaker plugged-out | <br>Mm<br>Mm<br>mm | <br>600<br>1330<br>2400 |
| | | | |
| **B** | **CIRCUIT BREAKERS** | | |
| | Type | | Vacuum |
| 1. | Reference Standard | | IEC 60694, IEC 62271-100, 62271-102, 62271-200 |
| 2. | Rated Voltage | KV | 33 |
| 3. | Rated Frequency | Hz | 50 |
| 4. | Rated Insulation Voltage | KV | 36 |
| 5. | No of Poles | | 3 |
| 6. | Nominal current rating | A | 1250 A |
| 7. | One Minutes Power frequency withstand Voltage | KV (rms) | 70 |
| 8. | 1.2/50 microsecond Impulse withstand Voltage | KV (peak) | 170 |
| 9. | Allowable Overcurrent for 1 sec | KA | 25 |
| 10. | Opening time | ms | <=70 |
| 11. | Breaking time | ms | <=80 |
| 12. | Closing time | ms | <=80 |
| 13. | Arcing time (max) | ms | |
| 14. | Rated operating cycle | | O-0.3s-CO-3min-CO |

| | | | |
|---|---|---|---|
| 15. | Breaking capacity of cable at no load | A | |
| 16. | Number of auxiliary contact for open/closed position of the circuit-breaker | O/O<br>O/C | |
| 17. | Auxiliary Supply voltage | V dc | 110 |
| 18. | Supply voltage for motor drive circuits | V dc | 110 |
| 19. | Allowable variation range of supply voltage | | +10%, - 15% |
| 20. | Coils Consumption:<br>- engagement coil<br>- release coil | A | |
| 21. | Consumption of arming motor | A | |
| 22. | Maximum noise level during opening and closing actuation | dB | |
| 23. | Degree of protection for auxiliary circuit | | IP 3X |

## 2. SECTIONALIZER & BUS RISER PANEL (GIS)

### 2.1 33 kV Interrupter Cubicles (ITC)

| Sr. No. | INDICATIONS | U | Values Required |
|---|---|---|---|
| **1** | | | |
| 2 | Manufacturer | | |
| 3 | Place of manufacture | | |
| **A** | Standards | | IEC 60694, IEC 62271-100, 62271-102, 62271-200 |
| 1 | **1) CUBICLE** | | |
| 2 | - Class | | Indoor |
| 3 | - Rated insulation voltage | kV | 36 |
| 4 | - Rated operating voltage | kV | 33 |
| 5 | - Rated frequency | Hz | 50 |
| 6 | - Rated short time duration power frequency withstand voltage | kV r.m.s. | 70 |
| 7 | - Rated lightning impulse withstand voltage | kV peak | 170 |
| 8 | - Cubicle rated current | A | 1250 |
| 9 | - Bar set rated current | A | 1250 |
| 10 | - Allowable overcurrent for 1 second | kA r.m.s. | 25 |
| 11 | - Instantaneous overcurrent | kA peak | 62.5 |
| 12 | - Number of flip-flop contacts for circuit-breaker plugging-in and plugging-out monitoring | minimum | |

| Sr. No. | INDICATIONS | U | Values Required |
|---|---|---|---|
| 13 | - Number of flip-flop contact for earthing isolator open/closed position monitoring | minimum | |
| 14 | - Number of flip-flop contacts for isolator open/closed position monitoring | minimum | |
| 15 | - Approximate dimensions of the cubicle<br>- Width<br>- Depth<br>- Height<br>- Depth with circuit-breaker plugged-out | <br>mm<br>mm<br>mm<br>mm | <br>600<br>1330<br>2400 |
| 16 | - Protection degree | | IP65 for HV, IP 3X for LV |
| 17 | - Earthing isolator making capacity | kA | |
| 18 | - Overall dimension drawing number | | |

| | INDICATIONS | U | Values Required |
|---|---|---|---|
| | **2) INTERRUPTER (Vacuum Type)** | | |
| | Three pole type | | |
| 1 | - Rated insulation voltage | kV | 36 |
| 2 | - Rated operating voltage | kV | 33 |
| 3 | - Rated frequency | Hz | 50 |
| 4 | - Rated short time duration power frequency withstand voltage | kV r.m.s. | 70 |
| 5 | - Rated lightning impulse withstand voltage | kV peak | 170 |

| | INDICATIONS | U | Values Required |
|---|---|---|---|
| 6 | - Rated short time duration power frequency withstand voltage across isolating distance | kV r.m.s. | |
| 7 | - Rated lightning impulse withstand voltage across isolating distance | kV peak | |
| 8 | - Rated current | A | 1250 |
| 9 | - Allowable overcurrent for 3 second | kA r.m.s. | 25 |
| 10 | - Instantaneous overcurrent | kA peak | 62.5 |
| 11 | - Breaking capacity | KA r.m.s | 25 |
| 12 | - Making capacity | kA peak | 62.5 |
| 13 | - Breaking mode: | | |
| 14 | - Opening time | ms | ≤70 |
| 15 | - Breaking time | ms | ≤80 |
| 16 | - Closing time | ms | ≤100 |
| 17 | - Number of auxiliary contact for open/closed position of the circuit-breaker | O/O<br>O/C | |
| 18 | - Auxiliary supply voltage | V dc | 110 |
| 19 | Supply voltage for motor drive circuits | V dc | 110 |
| 20 | - Allowable variation range of supply voltage | | +10%, -15% |
| 21 | - Power consumption of auxiliary | VA | |
| 22 | - Consumption of arming motor | A | |
| 23 | - Maximum noise level during opening and closing actuation | dB | |

| | INDICATIONS | U | Values Required |
|---|---|---|---|
| 24 | Degree of protection for auxiliary circuit | | IP3X |

## 3. CURRENT TRANSFORMER (GIS)

### 3.1 33KV CURRENT TRANSFORMER (TCT) FOR MVCB CELL

| INDICATIONS | U | Values Required |
|---|---|---|
| | | |
| Manufacturer | | |
| Place of manufacture | | |
| Port of embarkation | | |
| Standards | | IEC 44-1 |
| - Rated insulation voltage | kV | 36 |
| - Operating voltage | kV | 33 |
| - Rated frequency | Hz | 50 |
| - Rated power frequency short duration withstand voltage | kV | 70 |
| - Rated lightning impulse withstand voltage | kV | 170 |
| Actual transformation ratio | A | 200-100-50/ 1-1-1 |
| Secondary Core 1 - Protection<br>- Accuracy class<br>- Rated output | VA | 5P20 10 |
| Secondary Core 2 - Measurement<br>- Accuracy class | | 0.5, M5 |

| INDICATIONS | U | Values Required |
|---|---|---|
| - Rated output | VA | 10 |
| Secondary Core 3 - Protection<br>- Accuracy class<br>- Rated output | <br><br>VA | <br>PS<br>10 |
| Short-circuit current allowable for 3 seconds | kA | 12.5 |
| Permanent operation without danger | In | |
| Overheating | In | |
| Overcurrent class | | |
| | | |

## 3.2 PROTECTION CT (PCT) FOR CUT-OFF MOTORIZED CIRCUIT BREAKERS

| INDICATIONS | U | Values Required |
|---|---|---|
| Manufacturer | | |
| Place of manufacture | | |
| Port of embarkation | | |
| Standards | | IEC 44-1 |
| - Rated insulation voltage | kV | 36 |
| - Operating voltage | kV | 33 |
| - Rated frequency | Hz | 50 |
| - Rated power frequency short duration withstand voltage | kV | 70 |

| | | |
|---|---|---|
| - Rated lightning impulse withstand voltage | kV | 170 |
| Actual transformation ratio | A | 800-400 / 1/1/1 |
| Secondary Core 1 - Protection<br>- Accuracy class<br>- Rated output | <br><br>VA | <br>5P15<br>10 |
| Secondary Core 2 - Measurement<br>- Accuracy class<br>- Rated output | <br><br>VA | <br>0.5, M5<br>10 |
| Secondary Core 3 - Protection<br>- Accuracy class<br>- Rated output | <br><br>VA | <br>PS<br>10 |
| Short-circuit current allowable for 3 seconds | kA | 12.5 |
| Permanent operation without danger | In | |
| Overheating | In | |
| Overcurrent class | | |

## 4. 33 KV VOLTAGE TRANSFORMERS (GIS)

### 4.1 FOR SECTIONALIZER PANEL & BUS RISER PANEL AT ASS (VTCL)

| INDICATIONS | U | Values Required |
|---|---|---|
| Manufacturer | | |
| Place of manufacture | | |
| Port of embarkation | | |
| Standards | | IEC 186 |

| INDICATIONS | U | Values Required |
|---|---|---|
| - Primary insulation voltage | kV | 36 |
| - Operating voltage | kV | 33 |
| - Rated frequency | Hz | 50 |
| - Rated short-time duration power frequency withstand voltage | kV | 70 |
| - Rated lightning impulse withstand voltage | kV | 170 |
| Actual transformation ratio<br>- Primary winding<br>- secondary winding | <br>kV<br>V | <br>$33/\sqrt{3}$<br>$110/\sqrt{3}$ |
| Accuracy class | | 3P |
| Rated output | VA | 30 |

## 5. AUXILIARY TRANSFORMERS

### 5.1 AUXILIARY TRANSFORMER 3150 KVA (FOR METRO STATION / DEPOT POWER SUPPLY)

| INDICATIONS | U | Values Required |
|---|---|---|
| Manufacturer | | |
| Place of manufacture | | |
| Port of embarkation | | |
| Manufacturer drawing reference | | |
| Standards | | IEC 60076 |

| INDICATIONS | | U | Values Required |
|---|---|---|---|
| Insulation type | | | Cast resin |
| Rated power | AN | kVA | 3150 |
| | | | |
| Cooling mode | | | AN |
| Primary rated insulation voltage | | kV | 36 |
| Primary operating voltage | | kV | 33 |
| Secondary rated operating voltage | | V | 415/240 |
| Rated short duration power frequency withstand voltage for primary winding | | kV | 70 |
| Rated lightning impulse withstand voltage for primary winding | | kV | 170 |
| Short-circuit voltage | | % | 7% |
| Voltage setting (off load tap changer) | | % | 0.±2.5±5 |
| Vector Group | | | Dyn11 |
| Maximum noise level | | dBA | 65 dB at 1.5 meter |
| Maximum iron losses @ | | kW | As per Manufacture (Efficiency required is defined in Chapter-8) |
| Maximum load losses @ | | kW | As per Manufacture (Efficiency required is defined in Chapter-8) |
| Dimensions (maximum) * | | | |
| - Length | | mm | 2200 |
| - Width | | mm | 3000 |
| - Height | | mm | 2350 |

| INDICATIONS | U | Values Required |
|---|---|---|
| Weight (maximum) | kg | 8500 |

* Dimensions shown are indicative only

## 6. 110 V DC BATTERY CHARGER

| INDICATIONS | U | Values Required |
|---|---|---|
| Manufacturer | | |
| Type of battery charger | | Float Cum Boost Charger |
| | | |
| Standards | | IEC 146 |
| 3 Phases power supply | V AC | 415 |
| Frequency | Hz | 50 |
| Rated DC voltage | V DC | 110 |
| Power conversion | | Silicon diode/thyristor or thyristor bridge (Full Wave) for converting 3-phase supply to DC voltage. |
| Cooling | | Natural cooling |
| Allowable output voltage variation<br>- for +10% variation of supply voltage<br>- for +5% variation of frequency | | <br>+1%<br>+1% |
| Average winding Temperature rise over Ambient | Degree | 90 |

| INDICATIONS | U | Values Required |
|---|---|---|
| Internal Cabling /Wiring | | FRLSOH (For Underground) and FRLS for elevated section |
| Residual ripple ratio | | Less than 3 % |
| Recharge to 80% of the battery capacity | | 8 hours |
| **Meters** | | |
| Voltmeter on AC side | | To be provided |
| Voltmeter on DC side | | To be provided |
| Ammeter on DC side | | To be provided |
| **Alarms** | | To be provided |
| AC Main Fail | | To be provided |
| DC Overvoltage | | To be provided |

| INDICATIONS | U | Values Required |
|---|---|---|
| DC Under Voltage | | To be provided |
| Charging fail | | To be provided |
| Battery low | | To be provided |
| Battery Output Voltage | | To be Provided |
| One pair of Potential Free Contact grouping all fault to be provided for remote Annunciation at OCC | | To be provided |
| **Protections** | | |

| INDICATIONS | U | Values Required |
|---|---|---|
| Current Limit Protection | | To be provided |
| Soft start feature | | To be provided |
| Surge suppressor | | To be provided |
| HRC Fuse at rectifier Output | | To be provided |
| Battery Reverse Polarity protection | | To be provided |
| Automatic Changeover feature To be provided | | To be provided |
| Switchgear | | |
| Input Side | | MCCB/MCB & |
| Output side | | MCB & |

## 7. 110 V BATTERIES

| INDICATIONS | U | Values Required |
|---|---|---|
| Manufacturer | | |
| Place of manufacture | | |
| Port of embarkation | | |
| Standards | | IEC 622 |
| Type | | Ni-Cd in Polypropylene Container |
| Stationary compact | | |
| Maintenance free | | |

| INDICATIONS | U | Values Required |
|---|---|---|
| Capacity offered for 10 hours discharge duration | Ah | * |
| Voltage per cell | V | |
| Number of cells | | |
| Rated operating voltage | V DC | 110 |
| Maximum output current | A | |
| Documentation to be supplied | | |
| Dimensions<br>- Length<br>- Width | <br>mm<br>mm | |
| Total weight | kgf | |

* The capacity of the battery shall be designed by the Contractor taking into account the permitted voltage tolerance of the individual loads, the power consumption of various loads, the length of time they are in operation and the manner in which they draw power. The precise capacity of battery shall be determined to ensure total autonomy of the station for 8 hours. Battery capacity shall not be less than 180 AH, in any case.