**Section VI - Employer’s Requirements**

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**SUBSTATION - TECHNICAL DATA SCHEDULES**

# 400 kV OPEN TERMINAL SWITCHGEAR (GENERAL)

| **S.No** | **Description** | **Unit** | **Data Required** | **Data Offered** | |
| --- | --- | --- | --- | --- | --- |
| 1 | Standards | IEC | 62271, 62155, 60383, 60815,  ISO 9001 |  |
| 2 | Rated voltage | kV | 420 |  |
| 3 | System Voltage | kV | 400 |  |
| 4 | Rated frequency | Hz | 50 |  |
| 5 | Rated lightning impulse withstand voltage (at altitude <1000m) To be adjusted with the altitude |  |  |  |
|  | * Phase to earth | kVp | 1425 |  |
|  | * Phase to phase | kVp | 1425 |  |
|  | * Across the isolating distance | kVp | 1425 (+240) |  |
| 6 | Rated switching impulse withstand voltage (at altitude <1000m) To be adjusted with the altitude |  |  |  |
|  | * Phase to earth | kVp | 1050 |  |
|  | * Phase to phase | kVp | 1575 |  |
|  | * Across the isolating distance | kVp | 900 (+345) |  |
| 7 | Rated power frequency withstand voltage (at altitude <1000m) |  |  |  |
|  | * Phase to earth | kV | 520 |  |
|  | * Phase to phase | kV | 520 |  |
|  | * Across the isolating distance | kV | 610 |  |
| 8 | Rated short time withstand current (3 s) | kA | 40 |  |
| 9 | Rated peaks withstand current | kA | 100 |  |
| 10 | Material of HV conductor connectors |  | Aluminium |  |
| 11 | Type of Winding conductor |  | Copper |  |
| 12 | Material of contacts |  | Plain copper and Copper alloy |  |
| 13 | Minimum factors of safety for switchgear |  |  |  |
| 14 | * Busbars or other connections based on elastic limit |  | 2.5 |  |
| 15 | * Complete insulators based on electro-mechanical test |  | 2.5 |  |
| 16 | * Insulator metal fittings based on elastic limit |  | 2.5 |  |
| 17 | * Steel structures based on elastic limit of tension members and on crimping loads of compression members |  | 2.5 |  |
| 18 | * Foundations for structures against overturning or uprooting under maximum simultaneous working loadings |  | 2.5 |  |
| 19 | Creepage distance (based on Um) | mm/kV | 31 |  |
| 20 | Seismic factor | g | 0.25 |  |
| 21 | Altitude | M amsl | 2000 |  |
| 22 | Heating limit at 30°C ambient temperature | °C | 55 |  |
| 23 | Terminal’s cubicle – IP 65 | Yes/No | Yes |  |

# 132 kV OPEN TERMINAL SWITCHGEAR (GENERAL)

| **S.No** | **Description** | **Unit** | **Data Required** | **Data Offered** | |
| --- | --- | --- | --- | --- | --- |
| 1 | Standards | IEC | 62271, 62155, 60383, 60815,  ISO 9001 |  |
| 2 | Rated voltage | kV | 145 |  |
| 3 | System Voltage | kV | 132 |  |
| 4 | Rated frequency | Hz | 50 |  |
| 5 | Rated lightning impulse withstand voltage (at altitude <1000m) To be adjusted with the altitude |  |  |  |
|  | * Phase to earth | kVp | 650 |  |
|  | * Phase to phase | kVp | 650 |  |
|  | * Across the isolating distance | kVp | 650 (+240) |  |
| 6 | Rated switching impulse withstand voltage (at altitude <1000m) To be adjusted with the altitude | kVp | NA |  |
| 7 | Rated power frequency withstand voltage (at altitude <1000m) |  |  |  |
|  | * Phase to earth | kV | 275 |  |
|  | * Phase to phase | kV | 275 |  |
| 8 | Rated short time withstand current (3 s) | kA | 31.5 |  |
| 9 | Rated peaks withstand current | kA | 80 |  |
| 10 | Material of HV conductor connectors |  | Aluminium |  |
| 11 | Type of Winding conductor |  | Copper |  |
| 12 | Material of contacts |  | Plain copper and Copper alloy |  |
| 13 | Minimum factors of safety for switchgear |  |  |  |
| 14 | * Busbars or other connections based on elastic limit |  | 2.5 |  |
| 15 | * Complete insulators based on electro-mechanical test |  | 2.5 |  |
| 16 | * Insulator metal fittings based on elastic limit |  | 2.5 |  |
| 17 | * Steel structures based on elastic limit of tension members and on crimping loads of compression members |  | 2.5 |  |
| 18 | * Foundations for structures against overturning or uprooting under maximum simultaneous working loadings |  | 2.5 |  |
| 19 | Creepage distance (based on Um) | mm/kV | 31 |  |
| 20 | Seismic factor | g | 0.25 |  |
| 21 | Altitude | M amsl | 2000 |  |
| 22 | Heating limit at 30°C ambient temperature | °C | 55 |  |
| 23 | Terminals cubicle – IP 65 | Yes/No | Yes |  |

# 400 kV EQUIPMENT TECHNICAL DATA SHEETS

## 420 kV,4000A,40 kA-3sec CIRCUIT BREAKER

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Type |  | Single Pole, SF6 |  |
| 4 | Rated operating sequence |  | O -0.3 sec- CO -3 min - CO |  |
| 5 | Auto reclosing |  | O -0.3 sec- CO -3 min - CO |  |
| 6 | Rated making current | kAp | 100 |  |
| 7 | Rated breaking current | kA | 40 |  |
| 8 | Rated breaking current (asymmetrical) | kA | IEC 62271 |  |
| 9 | %dc | %dc |  |  |
| 10 | * Rated breaking current under out-of-phase conditions | kA | IEC 62271 |  |
| 11 | First pole to clear factor |  | 1.3 |  |
| 12 | Transient Recovery Voltages | TRVs | IEC 62271 |  |
| 13 | Rated capacitive breaking current |  | IEC 62271 |  |
| 14 | Rated line charging breaking current | A |  |  |
|  | * Rated cable charging breaking current | A |  |  |
|  | * Rated Single/Back-to-Back Capacitor bank breaking current | A |  |  |
|  | * Rated small inductive/reactor breaking currents of: |  | IEC 62271 |  |
| 15 | Small inductive | A |  |  |
|  | * reactor | A |  |  |
| 16 | Maximum overvoltage factor on any switching duty | pu | 2.3 |  |
| 17 | Maximum overvoltage factor when interrupting rated line/cable/capacitor bank charging currents | pu | 2.3 |  |
| 18 | Maximum overvoltage factor when switching small inductive/reactor currents | pu | 2.3 |  |
| 19 | Maximum total break time (trip initiation to final arc extinction) | ms | 60 |  |
| 20 | Opening time (trip initiation to contact separation) |  |  |  |
|  | * Without current | ms |  |  |
|  | * With 100% rated breaking current | ms |  |  |
| 21 | Maximum time interval between opening of first and last phase of three phase circuit breakers | ms | 3 |  |
| 22 | Maximum time interval between opening of interrupters of one phase | ms |  |  |
| 23 | Closing time from energisation of close coil to latching of circuit breaker in fully closed position | ms |  |  |
| 24 | Making time (energisation of close coil to contact touch) |  |  |  |
|  | * Without current | ms |  |  |
|  | * 100% making current | ms |  |  |
| 25 | Maximum time interval between closure of first and last phase of three phase circuit breaker | ms | 3.3 |  |
| 26 | Maximum time interval between closure of interrupters of one phase |  |  |  |
| 27 | Minimum time from extinction of main arc to contact make during auto-reclosing duty | ms |  | - |
| 28 | Mechanical life of circuit breaker and mechanism in No. of operations (Class M2) | Nos. | 10,000 |  |
| 29 | Electrical contact life in number of operations at: |  |  |  |
|  | Rated current - 4000 A |  |  |  |
|  | * Fault current - 40kA | Yrs | ≥20 |  |
|  | * Cumulative ampere rating |  |  |  |
| 30 | Number of current interrupting break units in series per phase |  | One/Two |  |
| 31 | Type of operating mechanism |  | DC Motor charged; spring operated |  |
| 32 | Type of power device (motor charged) |  |  |  |
|  | * For closing |  | Spring |  |
|  | * For opening |  | Spring |  |
| 33 | Hand operating facility | Yes/No | Yes |  |
| 34 | Manual spring release (suitably positioned to avoid accidental operation) | Yes/No | Yes |  |
| 35 | Mechanical on/off indicator | Yes/No | Yes |  |
| 36 | Mechanical spring charge / discharge indication | Yes/No | Yes |  |
|  | * Manual spring charging facility to be accessible from ground respectively platform to be provided | Yes/No | Yes |  |
| 37 | Charging time | s | ≤12 |  |
| 38 | Number of trip coils per phase |  | 2 |  |
| 39 | Number of close coils per phase |  | 1 |  |
| 40 | Nominal control and operating voltage | V | 110 DC |  |
| 41 | Nominal heater voltage | V | 240 AC |  |
| 42 | Rated power of trip coil | W |  |  |
| 43 | Rated power of close coil | W |  |  |
| 44 | Rated motor power | W |  |  |
| 45 | Total load of heaters for circuit breaker | W |  |  |
| 46 | Mass of circuit breaker complete (three pole) | kg |  |  |
| 47 | Mass of single-phase circuit breaker | kg |  |  |
| 48 | Emergency Trip Facility | Yes/No | Yes | - |
| 49 | Cubicle Light (Compact Fluorescent Light) | Yes/No | Yes |  |
| 50 | Number of Auxiliary Contacts |  | 10NO+10NC |  |
| 51 | SF6-Loss Rate/Year |  | ≤0.2% |  |
| 52 | Power Socket in Control Cubicle |  | British Standard |  |
| 53 | Closing Anti-pumping feature | Yes/No | Yes |  |
| 54 | Point on Wave (POW) Switching | Yes/No | Yes |  |
| 55 | Pole discrepancy feature | Yes/No | Yes |  |
| 56 | Circuit breaker Operating platform (from ground level) | Yes/No | Yes |  |
| 57 | Cubicle space heaters (thermostat Controlled) | Yes/No | Yes |  |
| 58 | Operational counter | Yes/No | Yes |  |
| 59 | Manufacturer quality system in accordance with ISO 9001:2015 | Yes/No | Yes |  |
|  | * Date of issue |  | Latest |  |
|  | * Validity |  |  |  |
|  | * Certificate attached to the offer |  |  |  |
| 60 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
|  | Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 61 | Standards | IEC | 62271, 60376, 60480, 60947, |  |

## 420 kV,4000A,40 kA-3sec DISCONNECT SWITCH

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of Manufacturing |  |  |  |
| 2 | Type designation  Arching plate for each arm of Insulator |  |  |  |
| 3 | Type of operating mechanism |  | DC Motor |  |
| 4 | Maximum capacitive current that can be interrupted by the isolator | A |  |  |
| 5 | Total time from initiation of opening operation to isolator in fully open position | s | ≤15 |  |
| 6 | Time from contact separation to extinct of capacitive arc | S |  |  |
| 7 | Total time from initiation of opening operation to time when isolator gap can withstand phase voltage | s |  |  |
| 8 | Hand operating facility | Yes/No | Yes |  |
| 9 | Locking arrangement in on/off position  -Mechanical/Electrical  Locking arrangement when control cubicle is open | Yes/No  Yes/N0 | Yes  Yes |  |
| 10 | Mechanical life of disconnector switch and mechanism in no. of operations |  | 10,000  (M2 class) |  |
| 11 | Nominal control and operating voltage | V | 110 DC |  |
| 12 | Automatic isolation of control supplies when lock off | Yes/No | Yes |  |
| 13 | Accessibility to operating mechanism from ground level | Yes/No | Yes |  |
| 14 | Nominal heater voltage | V | 240 AC |  |
| 15 | Rated power of operation coil | W |  |  |
| 16 | Rated motor power | W |  |  |
| 17 | Total load of heaters for isolator | W |  |  |
| 18 | Total mass of three phase isolator complete | kg |  |  |
| 19 | Mass of single-phase isolator | kg |  |  |
| 20 | Contact type/Material |  | silver plated copper |  |
| 21 | Type of interlocking |  | Electrical and Mechanical |  |
| 22 | Cubicle Light/heater/power socket (Compact Fluorescent Light) | Yes/No | Yes |  |
| 23 | Number of Auxiliary Contacts |  | 10NO+10NC |  |
| 24 | Cubicle space heaters (thermostat Controlled) | Yes/No | Yes |  |
| 25 | Automatic isolation of control supply upon loss of motor supply | Yes/No | Yes |  |
| 26 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | Yes |  |
|  | * Date of issue |  | Latest |  |
|  | * Validity |  | Yes |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 27 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted Not older than 5 years | Yes/No | Yes |  |
| 28 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 29 | * Standards |  | IEC 62271,60273  ,60947 |  |

## 420 kV,4000A, 40kA-3sec EARTHING SWITCH

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & place of manufacturing | - |  |  |
| 2 | Type designation | - |  |  |
| 3 | Type of operating mechanism | - | DC -Motor |  |
| 4 | Hand operating facility | Yes/No | Yes |  |
| 5 | Locking arrangement in on/off position  Locking arrangement when control cubicle is open | Yes/No  Yes/No | Yes  Yes |  |
| 6 | Nominal control and operating voltage | V | 110 DC |  |
| 7 | Automatic isolation of control supplies when lock off | Yes/No | Yes |  |
| 8 | Accessibility to operating mechanism from ground level | Yes/No | Yes |  |
| 9 | Nominal heater voltage | V | 240 AC |  |
| 10 | Total load of heaters for earthing switch | W |  |  |
| 11 | Total mass of earthing switch complete | kg |  |  |
| 12 | Type of Interlocking |  | Electrical and Mechanical |  |
| 13 | Cubicle Light/heater/ power socket | Yes/No | Yes |  |
| 14 | Number of Auxiliary Contacts |  | 10NO+10NC |  |
| 15 | Automatic isolation of control supply upon loss of motor supply | Yes/No | Yes |  |
| 16 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | Yes |  |
|  | * Date of issue | - | Latest |  |
|  | * Validity | - |  |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 17 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted, not older than 5 years | Yes/No | Yes |  |
| 18 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 19 | * Standards | - | IEC 62271,60273  ,60947 |  |

## 420 kV, 4000-2000/1000/1A, CURRENT TRANSFORMER-DIAMETER CT-Line

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing | - |  |  |
| 2 | Type | - |  |  |
| 3 | Rated continuous thermal current at 40°C | - | Rated extended primary current |  |
| 4 | Number of cores | - | 3 |  |
| 5 | Rated extended primary current | - | 120% |  |
| 6 | Ratio (TR – turns ratio) | - |  |  |
|  | * Change of CT ratio shall be possible at the secondary circuit only | Yes/No | Yes |  |
|  | * Core I | A | 4000-2000/1000/1 |  |
|  | * Core II | A | 4000-2000/1000/1 |  |
|  | * Core III | A | 4000-2000/1000/1 |  |
| 7 | Class |  |  |  |
|  | * Core I | - | TPY |  |
|  | * Core II | - | 5P20 |  |
|  | * Core III | - | 5P20 |  |
| 8 | Knee point voltage (Ek) |  |  |  |
|  | * Core I | V |  |  |
|  | * Core II | V |  |  |
|  | * Core III | V |  |  |
| 9 | Exciting current (IE) at Ek |  |  |  |
|  | * Core I | mA |  |  |
|  | * Core II | mA |  |  |
|  | * Core III | mA |  |  |
| 10 | Rated output (burden to be 25-100% rated burden) |  |  |  |
|  | * Core I | VA | 20 |  |
|  | * Core II | VA | 20 |  |
|  | * Core III | VA | 20 |  |
| 11 | Total mass of single-phase current transformer complete | kg |  |  |
| 12 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | * Date of issue |  | Latest |  |
|  | * Validity |  | Yes |  |
|  | * Certificate attached to the offer | Yes/No |  |  |
| 13 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 14 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 15 | * Standards | - | IEC 61869 |  |

## 420 kV, 4000-2000/1000/1A, CURRENT TRANSFORMER-DIAMETER CT-Transformer

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing | - |  |  |
| 2 | Type | - |  |  |
| 3 | Rated continuous thermal current at 40°C | - | Rated extended primary current |  |
| 4 | Number of cores | - | 3 |  |
| 5 | Rated extended primary current | - | 120% |  |
| 6 | Ratio (TR – turns ratio) | - |  |  |
|  | * Change of CT ratio shall be possible at the secondary circuit only | Yes/No | Yes |  |
|  | * Core I | A | 4000-2000/1000/1 |  |
|  | * Core II | A | 4000-2000/1000/1 |  |
|  | * Core III | A | 4000-2000/1000/1 |  |
| 7 | Class |  |  |  |
|  | * Core I | - | 5P20 |  |
|  | * Core II | - | 5P20 |  |
|  | * Core III | - | 5P20 |  |
| 8 | Knee point voltage (Ek) |  |  |  |
|  | * Core I | V |  |  |
|  | * Core II | V |  |  |
|  | * Core III | V |  |  |
| 9 | Exciting current (IE) at Ek |  |  |  |
|  | * Core I | mA |  |  |
|  | * Core II | mA |  |  |
|  | * Core III | mA |  |  |
| 10 | Rated output (burden to be 25-100% rated burden) |  |  |  |
|  | * Core I | VA | 20 |  |
|  | * Core II | VA | 20 |  |
|  | * Core III | VA | 20 |  |
| 11 | Total mass of single-phase current transformer complete | kg |  |  |
| 12 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | * Date of issue |  | Latest |  |
|  | * Validity |  | Yes |  |
|  | * Certificate attached to the offer | Yes/No |  |  |
| 13 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 14 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 15 | * Standards | - | IEC 61869 |  |

## 420 kV, 4000-2000/1A, CURRENT TRANSFORMER – (Metering CT)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing | - |  |  |
| 2 | Type Designation | - | Post |  |
| 3 | Rated continuous thermal current at 40°C | - | Rated extended primary current |  |
| 4 | Number of cores | - | 2 |  |
| 5 | Rated extended primary current | - | 120% |  |
| 6 | Ratio (TR – turns ratio) | - | - |  |
|  | * Change of CT ratio shall be possible at the secondary circuit only | Yes/No | Yes |  |
|  | * Core I | A | 4000-2000/1 |  |
|  | * Core II | A | 4000-2000/1 |  |
| .7 | Class |  |  |  |
|  | * Core I | - | 0.2S |  |
|  | * Core II | - | 0.2S |  |
| 8 | Knee point voltage (Ek) |  |  |  |
|  | * Core I | V |  |  |
|  | * Core II | V |  |  |
| 9 | Exciting current (IE) at Ek |  | - |  |
|  | * Core I | mA |  |  |
|  | * Core II | mA |  |  |
| 10 | Rated output (burden to be 25-100% rated burden) |  | - |  |
|  | * Core I | VA | 15 |  |
|  | * Core II | VA | 15 |  |
| 11 | Secondary terminals cubicle -IP 55 | YES/No | YES |  |
| 12 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 13 | Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 14 | Total mass of single-phase current transformer complete | kg |  |  |
| 15 | Secondary Circuit Protection |  | MCB |  |
| 16 | Standards | - | IEC 61869 |  |

## 420 kV CAPACITIVE VOLTAGE TRANSFORMER

| **S. No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing | - |  |  |
| 2 | Type | - | Capacitive |  |
| 3 | Maximum permissible partial discharge level at Um | pC | 10 |  |
| 4 | Maximum permissible partial discharge level at 1.2Um /√3 | pC | 5 |  |
| 5 | Method of suppressing Ferro resonance phenomena | - | RLC Dumping |  |
| 6 | Number of secondary’s | - | Three |  |
| 7 | Rated voltage factor | - | 1.5PU, 30secs |  |
| 8 | Rated transformation ratio | - |  |  |
|  | * Secondary I | kV | 400/√3/0.11/√3 |  |
|  | * Secondary II | kV | 400/√3/0.11/√3 |  |
|  | * Secondary III | kV | 400/√3/0.11/√3 |  |
| 9 | Rated accuracy class |  |  |  |
|  | * Secondary I | - | 3P/1.0 |  |
|  | * Secondary II | - | 3P/1.0 |  |
|  | * Secondary III | - | 3P/1.0 |  |
| 10 | Rated output (burden to be 25-100% rated burden) |  |  |  |
|  | * Secondary I | VA | 100 |  |
|  | * Secondary II | VA | 100 |  |
|  | * Secondary III | VA | 100 |  |
| 11 | Mass of single-phase voltage transformer | kg |  |  |
| 12 | Secondary terminals cubicle IP 55 | Yes/No | Yes |  |
| 13 | Secondary circuit protection |  | MCB |  |
| 14 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | Yes |  |
|  | * Date of issue | - | Latest |  |
|  | * Validity | - | Yes |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 15 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 16 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 17 | * Standards | - | IEC 61869 |  |

## 420 kV CAPACITIVE VOLTAGE TRANSFORMER- (METERING)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing |  |  |  |
| 2 | Type | - | Capacitive |  |
| 3 | Maximum permissible partial discharge level at Um | pC | 10 |  |
| 4 | Maximum permissible partial discharge level at 1.2Um /√3 | pC | 5 |  |
| 5 | Method of suppressing Ferro resonance phenomena |  | RLC Dumping |  |
| 6 | Number of secondary’s | - | 2 |  |
| 7 | Rated voltage factor | - | 1.5PU, 30secs |  |
| 8 | Rated transformation ratio |  |  |  |
|  | * Secondary I | kV | 400/√3/0.11/√3 |  |
|  | * Secondary II | kV | 400/√3/0.11/√3 |  |
| 9 | Rated accuracy class |  |  |  |
|  | * Secondary I | - | 0.2 |  |
|  | * Secondary II | - | 0.2 |  |
| 10 | Rated output (burden to be 25-100% rated burden) |  |  |  |
|  | * Secondary I | VA | 50 |  |
|  | * Secondary II | VA | 50 |  |
| 11 | Mass of single-phase voltage transformer | kg |  |  |
| 12 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | Yes |  |
|  | * Date of issue | - | Latest |  |
|  | * Validity | - | yes |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 13 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 14 | * Secondary terminals cubicle IP 55 | Yes/No | Yes |  |
| 15 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 16 | * Standards | - | IEC 61869 |  |

## 420 kV,4000A,40 kA-3sec TUBULAR BUSBAR

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Tubular |  |
| 3 | Catalogue No. | - |  |  |
| 4 | Country of origin | - |  |  |
| 5 | Characteristics | - |  |  |
|  | Material | - | Aluminum/ Aluminium alloy |  |
|  | Designation | - |  |  |
|  | Conductivity (% IACS) | % | 53min. |  |
|  | Resistance at 20 oC | Ω | 0.033 min. |  |
|  | Short-circuit current rating / duration | kA/s | 40 kA/3sec |  |
|  | Normal current rating |  |  |  |
|  | at 40oC | A | 4000 |  |
|  | at 50oC | A | 4000 |  |
| 6 | Exterior diameter | mm | 200min. |  |
| 7 | Interior diameter | mm | 180min. |  |
| 8 | Section | mm2 |  |  |
| 9 | Bar section length | m |  |  |
| 10 | Linear weight | kg/m |  |  |
| 11 | Maximum span | m | 24 |  |
| 12 | Transportation |  |  |  |
|  | Number of tubes per crate | - |  |  |
|  | Dimensions of crate | mm |  |  |
|  | Weight of crate | mm |  |  |
| 13 | Standards | - | IEC 60105 ASTM B317 ANSI H35.2 |  |
| 14 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | ISO 9001 |  |
| 15 | Installation | - | Outdoor |  |

## 420 kV,4000A,40 kA-3sec STRAIN BUSBAR CONDUCTOR

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type |  | AAAC |  |
| 3 | Code Name | - | ASTER 1144 |  |
| 4 | Designation | - |  |  |
| 5 | Country of Origin | - |  |  |
|  | Mechanical characteristics and dimensions |  |  |  |
| 6 | Stranding | nos | 91 |  |
| 7 | Aluminium wire diameter | mm | 4 |  |
| 8 | Overall diameter | mm | 44 |  |
| 9 | Aluminium area | mm2 | 1143.5 |  |
| 10 | Nominal área | mm2 | 1144 |  |
| 11 | Rated current | A |  |  |
| 12 | Mass | kg/km | 3348 |  |
| 13 | Rated tensile strength | KN | 360.22 |  |
| 14 | Initial lower modulus of elasticity | GPa |  |  |
| 15 | Initial upper modulus of elasticity | GPa |  |  |
| 16 | Transition stress | MPa |  |  |
| 17 | Final modulus of elasticity | GPa | 52500 |  |
| 18 | Creep modulus at 15ºC | GPa |  |  |
| 19 | Coefficient of linear thermal expansion | E-6/ºC | 23 |  |
| 20 | D.C. resistance at 20ºC | ohms/km | 0.0293 |  |
|  | Transport |  |  |  |
| 21 | Standard length of conductor per reel | m |  |  |
| 22 | Maximum number of standard lengths per reel |  |  |  |
| 23 | Flange Diameter | mm |  |  |
| 24 | Inside traverse | mm |  |  |
| 25 | Overall width | mm |  |  |
| 26 | Drum Diameter | mm |  |  |
| 27 | Minimum cover from edge of flange | mm |  |  |
| 28 | Arbor hole diameter | - |  |  |
| 29 | Material | mm |  |  |
| 30 | Empty reel mass | Kg |  |  |
| 31 | Thickness of lagging | mm |  |  |
| 32 | Shipping mass | kg |  |  |
| 33 | Shipping volume | m3 |  |  |
| 34 | Standards |  | IEC 60889 |  |
| 35 | Quality Assurance | - | ISO 9001 |  |
| 36 | Installation | - | Outdoor |  |

## 420 kV,4000A,40 kA-3sec BUSBAR CONNECTORS AND HARDWARE

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Country of origin | - |  |  |
|  | Characteristics |  |  |  |
| 3 | Sizes of bus conductors: |  |  |  |
|  | rigid 400 kV busses |  | 200 mm min. |  |
|  | flexible conductor |  | ASTER 1144 mm2 |  |
| 4 | Rated current | A | 4000 |  |
| 5 | Resistance vs resistance of the conductor | % |  |  |
| 6 | Radio influence voltage (IEC 60694) at 140 % rated voltage at 0.5 MHz | µV |  |  |
| 7 | Frequency | Hz | 50 |  |
| 8 | Connector’s type (non-limitative) |  |  |  |
|  | Shielding rings | - |  |  |
|  | bus support | - |  |  |
|  | bus flexible support | - |  |  |
|  | rigid-flexible connectors | - |  |  |
|  | angle A, Y connectors | - |  |  |
|  | T connectors | - |  |  |
|  | Expansion connectors | - |  |  |
|  | pad connectors | - |  |  |
|  | union connectors | - |  |  |
|  | Caps | - |  |  |
| 9 | Material of connectors | - | Aluminium Alloy |  |
| 10 | Conductivity (IACS) | % | 35 min. |  |
| 11 | Short-circuit withstand | kA | 40 for 3Sec |  |
| 12 | Various bolt size used for: |  |  |  |
|  | 400 kV bus bars | mm |  |  |
|  | Conductors for 400 kV | mm |  |  |
|  | Material of bolts | mm | AL 7075T73 or equivalent |  |
| 13 | Tightening torque for bolts |  |  |  |
|  | size and torque – bolt #1 | - |  |  |
|  | size and torque – bolt #2 | - |  |  |
|  | size and torque – bolt #3 | - |  |  |
|  | size and torque – bolt #4 | - |  |  |
|  | size and torque – bolt #5 | - |  |  |
| 14 | Resistance to traction |  |  |  |
|  | connector on stranded conductor | % | 10 |  |
|  | connector on tube | KN | 2 min. |  |
| 15 | Strength of bus support |  |  |  |
|  | stranded conductor (long., vert., trans.) | KN | 18 |  |
|  | bus tube (long., vert., trans.) | KN | 18 |  |
| 16 | Tests |  |  |  |
|  | cyclic heat run test | - | YES |  |
|  | short circuit current withstands | - | YES |  |
|  | mechanical strength | - | YES |  |
|  | resistance to traction | - | YES |  |
|  | bolts over-tightening resistance | - | YES |  |
|  | radio interference | - | YES |  |
|  | routine dimensions check | - | YES |  |
|  | chemical analysis of material | - | YES |  |
|  | radiography test | - | YES |  |
| 17 | Weight and dimension |  |  |  |
|  | Average weight of item | kg |  |  |
|  | Average packing dimension | mm |  |  |
|  | Number of items per crate | - |  |  |
|  | Dimensions of crate | mm |  |  |
|  | Weight of crate | kg |  |  |
| 18 | Standards |  | NEMA CC-1, ANSI C119.4, ASTM B26/B26M, ASTM B108, ASTM B193, ASTM E155 |  |
| 19 | Quality control |  | ISO 9001 |  |
| 20 | Installation |  | Outdoor in tropical/ desert environment |  |

## 420 kV POST TYPE INSULATORS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| 1 | Manufacturer |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Insulator material |  | Brown Glazed Porcelain |  |
| 4 | Number of units in complete post insulator |  |  |  |
| 5 | Length of each unit | mm |  |  |
| 6 | Mass of complete post insulator | kg |  |  |
| 7 | Maximum cantilever working load (complete post insulator) | kN | at design stage |  |
| 8 | Minimum cantilever breaking load, upright (complete post insulator) | kN |  |  |
| 9 | Power frequencies withstand voltage dry | kV | 520 |  |
| 10 | Basic insulation level | kV |  |  |
| 11 | Minimum dry/wet switching surge withstand level | kV | 1050 |  |
| 12 | Radio influence voltage level measured at 1.1 times Us/√3 at 1 MHz | µv |  |  |
| 13 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | * Date of issue |  | Yes |  |
|  | * Validity |  | Latest |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 14 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted Not older than 5 years | Yes/No | Yes |  |
| 15 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 16 | * Standards |  | IEC 60273,  IEC 60815  IEC 60168  IEC 60660 |  |

## 420 kV TENSION/suspension INSULATORS(longrod)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| 1 | Manufacturer |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Insulator material |  | Silicone rubber |  |
| 4 | Coupling |  | Ball and socket |  |
| 5 | Colour/Surface |  | Grey/Smooth |  |
| 6 | Housing |  | Single mold |  |
| 7 | Ball and socket diameter | mm | 20 |  |
| 8 | Min. creepage distance | mm | 13020 |  |
| 9 | Maximum working load | KN | 160 |  |
| 10 | Outside diameter |  |  |  |
| 11 | Number of sheds |  |  |  |
| 10 | Power frequencies withstand voltage of complete string  Wet  Dry | kV  kV | 820  680 |  |
| 11 | Impulse withstand voltage | kVp | 1550 |  |
| 12 | Visual corona discharge voltage | kVrms | 320 |  |
| 13 | Radio influence voltage measured at 1.1 times Us/√3 at 1 MHz | µv | 50 |  |
| 14 | Total length with hardware | mm |  |  |
| 15 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | * Date of issue |  | Yes |  |
|  | * Validity |  | Latest |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 16 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 17 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 18 | * Standards |  | IEC 61109  IEC 60372  IEC 60120 |  |

## 360 kV, 10kA, Class-5 SURGE ARRESTERS

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Country and Type |  | MOA |  |
| 2 | Maximum overvoltage factor on the system due to any switching duty | pu | 2.3 |  |
| 3 | Condition of system neutral |  | Solid |  |
| 4 | Nominal Discharge current | kAc rest | 20 |  |
| 5 | Energy capability as per IEC 60099-4 | kJ/kV |  |  |
| 6 | Rated Voltage – MOA | kV | 360 |  |
| 7 | Long duration discharge class as per IEC 99-1 | Class | 5 |  |
| 8 | Maximum Continuous Operating Voltage (COV) | kV | 260 min |  |
| 9 | TOV capability for |  |  |  |
|  | * 1sec | kV |  |  |
|  | * 10sec | kV |  |  |
| 10 | Maximum residual voltage with current wave |  |  |  |
|  | * Switching Surges – 1kA/2kA | kV | To be specified by Bidder/ IEC 60099-4 |  |
|  | * 8/20 μs – 5kA | kV | To IEC 60099 |  |
|  | * 8/20 μs – 20kA | kV | To IEC 60099 |  |
| 11 | Discharge currents withstand strength |  |  |  |
|  | * High current 4/10 μs | KA p | To IEC 60099 |  |
|  | * Low current 2000 μs | KA p | To IEC 60099 |  |
| 12 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | To IEC 60099 |  |
|  | * Date of issue |  | Yes |  |
|  | * Validity |  | Latest |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 13 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
|  | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 14 | Standard |  | IEC 60099 |  |

# 132 kV EQUIPMENT TECHNICAL DATA SHEETS

## 145 kV,2000A, 31.5kA-3 sec, CIRCUIT BREAKER (OHL)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer | - |  |  |
| 2 | Type | - | SF6 |  |
| 3 | Model no. | - |  |  |
| 4 | Country of origin | - |  |  |
| 5 | Number of poles | - | 3 |  |
| 6 | Operation | - | Single pole operated |  |
| 7 | Rated current | A | 2000A |  |
| 8 | Short circuit breaking current | kA RMS | 31.5 |  |
| 9 | Voltage | kV | 145 |  |
| 10 | Short time with stand | s | 3 |  |
| 11 | DC component time constant | ms | 45 |  |
| 12 | Rated making current | KA | 80 |  |
| 13 | Rated breaking current (asymmetry) | KA | As per IEC 62271 |  |
| 14 | Breaking time | ms | ≤ 30 |  |
| 15 | First pole to clear factor |  | 1.3 |  |
| 16 | Closing time | ms | ≤ 100 |  |
| 17 | Operating sequence | ms | O-0,3 s  CO-3 min-CO |  |
| 18 | Annual rate of gas leakage at normal pressure of | % Bar | ≤ 0.5 |  |
| 19 | Creep age distance | mm/kV | 31 |  |
| 20 | Rated TRV for faults at terminals |  |  |  |
|  | TRV crest value | kV | as per IEC62271 |  |
|  | TRV rate of rise | kV/μs | as per IEC62271 |  |
|  | initial TRV | kV | as per IEC62271 |  |
|  | time to crest of initial TRV | μs | as per IEC62271 |  |
|  | TRV crest value | kV | as per IEC62271 |  |
|  | TRV rate of rise | kV/μs | as per IEC62271 |  |
|  | surge impedance | ohms | as per IEC62271 |  |
|  | Rated out-of-breaking capability |  |  |  |
|  | Rated out-of-phase current | kA | as per IEC62271 |  |
|  | Power frequency recovery voltage | kV | as per IEC62271 |  |
|  | Rated TRV out-of-phase breaking |  |  |  |
|  | TRV crest value | kV | as per IEC62271 |  |
|  | TRV rate of rise | kV/μs | as per IEC62271 |  |
|  | Rated line charging breaking capability |  |  |  |
|  | Rated line charging breaking current (no restrike) | A | as per IEC62271 |  |
|  | TRV crest value | kV | as per IEC62271 |  |
|  | * TRV duration after breaking | s |  |  |
| 21 | * Radio Interference Voltage (RIV) |  |  |  |
|  | RIV max voltage level (IEC 694) at 0,5 MHz and 145 kV test voltage | μV | <2500 |  |
| 22 | * Capacitors across terminal | pF | - |  |
| 23 | * Number of operations without maintenance |  |  |  |
|  | * CO at no load | - | 10000 |  |
|  | CO at rated current | - | 1000 |  |
|  | * CO at rated breaking current | - | 120 |  |
|  | MV terminals connectors |  | TBA |  |
| 24 | Operatingmechanism (for opening and closing) |  |  |  |
|  | * Type | - | Spring mechanism |  |
|  | * Motor voltage | V dc | 110 |  |
|  | * Nominal control voltage | Vdc | 110 |  |
|  | Closing and opening coil voltage | V dc | 110 |  |
|  | Number of closing coils per pole | Nos | 1 |  |
|  | Number of opening coils with separate core per pole | Nos | 2 |  |
|  | Number of auxiliary contacts available | - | 10 NO + 10 NC |  |
|  | Spring Charging time | s | ≤12 |  |
|  | Synchronized pole switching | - | Yes. All three poles closing on single close command for transmission& autotransformer feeder |  |
|  | Number of current interruptions |  | One |  |
|  | Mechanical life of circuit breaker and mechanism in no. of operations |  | 10,000  (M2 class) |  |
| 25 | DimensionsandMass |  |  |  |
|  | Between poles | mm |  |  |
|  | total height | mm |  |  |
|  | support insulator height | mm |  |  |
|  | metal support height | mm | 2500 |  |
|  | total mass, 3 poles group | kg |  |  |
| 26 | * Ladder | mm | yes |  |
| 27 | * Accessoriesinthemotormech*.* Enclosure |  |  |  |
| 28 | * Operations counter | Yes/No | Yes |  |
| 29 | * Spring Charged/Discharged mechanical indication | Yes/No | Yes |  |
| 30 | * Mechanical on/off indicator | Yes/No | Yes |  |
| 31 | * Local manual control | - | Yes |  |
| 32 | Thermostat controlled space heater | Yes/No | Yes |  |
| 33 | Nominal Heater voltage | VAC` | 240 |  |
| 34 | Total load of heaters of the circuit breaker | W |  |  |
| 35 | Weatherproof, corrosion resistance enclosure with double EPDM rubber lining. | - | IP 65 |  |
| 36 | Double motion mechanism for pole opening | Yes/No | Yes | - |
| 37 | Accessoriesinthecentralcontrolpanel |  |  |  |
| 38 | Anti-pumping relay | Yes/No | Yes |  |
| 39 | Local/Remote selector switch | Yes/No | Yes |  |
| 40 | Local operation push buttons/levers with spring return (T-N-C switch) | Yes/No | Yes |  |
| 41 | Emergency trip lever shall be available without opening access doors. | Yes/No | Yes |  |
| 42 | Minimum pressure lock-out and alarm relay | Yes/No | Yes |  |
| 43 | Door limit switch controlled compact fluorescent lighting (CFL) | Yes/No | Yes |  |
| 44 | Standard British type power socket outlet | Yes/No | Yes |  |
| 45 | Phase/pole discrepancy timer and relay | Yes/No | Yes |  |
| 46 | Rated power of Trip coil | W |  |  |
| 47 | Rated power of close coil | W |  |  |
| 48 | Rated motor power | W |  |  |
| 49 | Operating voltage range for trip coil | % Of 110vdc | 70% to 110% |  |
| 50 | Operating voltage range for close coil | % Of 110vdc | 85% to 110% |  |
| 51 | Mounting brackets and hardware | - |  |  |
| 52 | SYN switch relay | - | yes |  |
| 53 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | Date of issue |  | Yes |  |
|  | Validity |  | Latest |  |
|  | Certificate attached to the offer | Yes/No | Yes |  |
| 54 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
|  | Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 55 | Standards |  | IEC 62271, IEC 60056, IEC 60694 |  |
| 56 | Installation |  | Outdoor, desert/tropical environment |  |

## 145 kV,2000A, 31.5kA-3 sec, CIRCUIT BREAKER

(Gang operated - Three Poles for Transformer; Bus section; Bus Coupler)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer | - |  |  |
| 2 | Type designation | - | SF6 |  |
| 3 | Model no. | - |  |  |
| 4 | Country of origin | - |  |  |
| 5 | Nominalcharacteristics |  |  |  |
| 6 | Rated maximum voltage | kV | 145 |  |
| 7 | Number of poles | - | 3 |  |
| 8 | Operation | - | three poles for power transformer, Bus section and Bus coupler switching |  |
| 9 | Rated current | A | 2000 |  |
| 10 | Short circuit breaking current | kA RMS | 31,5 |  |
| 11 | Voltage | kV | 145 |  |
| 12 | Short time withstand | S | 3 |  |
| 13 | DC component time constant | ms | 45 |  |
| 14 | Breaking time | ms | ≤ 30 |  |
| 15 | Closing time | ms | ≤ 100 |  |
| 16 | Operating sequence | - | O-0,3 s CO-3 min-CO |  |
| 17 | Annual rate of gas leakage at normal pressure of | % Bar | ≤ 0.5 |  |
| 18 | Creep age distance | mm/kV | 31 |  |
| 19 | Rated TRV for faults at terminals |  |  |  |
|  | * TRV crest value | kV | as per IEC62271 |  |
|  | * TRV rate of rise | kV/μs | as per IEC62271 |  |
|  | * initial TRV | kV | as per IEC62271 |  |
|  | * time to crest of initial TRV | μs | as per IEC62271 |  |
| 20 | Rated TRV for short line fault |  |  |  |
|  | * TRV crest value | kV | as per IEC62271 |  |
|  | * TRV rate of rise | kV/μs | as per IEC62271 |  |
|  | * initial TRV | kV | as per IEC62271 |  |
|  | * time to crest of initial TRV | μs | as per IEC62271 |  |
| 21 | Radio interference voltage |  |  |  |
|  | * RIV max voltage (IEC 694) at 0,5 MHz and 145 kV test voltage | μV | as per IEC62271 |  |
| 22 | Capacitors across terminals | pF | <2500 |  |
| 23 | * Number of operations without  maintenance |  |  |  |
|  | * CO at no load |  | 10000 |  |
|  | * CO at rated current |  | 1000 |  |
|  | * CO at rated breaking current |  | 120 |  |
| 24 | HV terminal connectors for | - | TBA |  |
| 25 | Operating mechanism |  |  |  |
|  | Type | - | Spring mechanism |  |
|  | Motor voltage | V dc | 110 |  |
|  | Closing and opening coil voltage | V dc | 110 |  |
|  | Number of closing coils | - | 1 |  |
|  | Number of opening coils with separate core | - | 2 |  |
|  | Rated power of trip coil | W |  |  |
|  | Rated power of closing coil | W |  |  |
|  | Rated power of motor | W |  |  |
|  | Mechanical life of circuit breaker and mechanism in no. of operations |  | M2 class (10,000) operations |  |
|  | Number of current interruptions in series per phase |  | One |  |
|  | Double motion mechanism for pole opening | Yes/No | Yes |  |
| 26 | Number of auxiliary contacts available | - | 10 NO, 10 NC |  |
| 27 | Dimensions and weight: |  |  |  |
|  | * between poles | mm |  |  |
|  | * total height | mm |  |  |
|  | * support insulator height | mm |  |  |
|  | * metal support height | mm |  |  |
|  | * total mass, 3 poles group | kg |  |  |
|  | * transportation dimensions | mm |  |  |
|  | * transportation mass | kg |  |  |
|  | * Ladder |  |  |  |
| 28 | Accessories in the motor mech. enclosure |  |  |  |
| 29 | Operation counter | Yes/No | Yes |  |
| 30 | Mechanical Spring Charged/Discharged indication | Yes/No | Yes |  |
|  | Mechanical on/off indication | Yes/No | Yes |  |
| 31 | Local operation push buttons/levers with spring return (T-N-C switch) | Yes/No | Yes |  |
| 32 | Thermostat controlled space Heater | Yes/No | Yes |  |
|  | Total load of heaters for the Circuit breaker | W |  |  |
|  | Nominal Heater voltage | VAC | 240 |  |
|  | Operating voltage range for trip coil | % of 110vdc | 70% to 110% |  |
|  | Operating voltage range for close coil | % of 110vdc | 85% to 110% |  |
| 33 | Weatherproof, corrosion resistance enclosure | - | IP 65 |  |
| 34 | Accessoriesinthecentralcontrolpanel |  |  |  |
|  | Anti-pumping relay | Yes/No | Yes |  |
|  | Local/Remote selector switch | Yes/No | Yes |  |
|  | Local operation push buttons | - | Yes |  |
|  | Emergency trip lever shall be available without opening access doors | Yes/No | Yes |  |
|  | Minimum pressure lock-out and alarm relay | Yes/No | Yes |  |
|  | Door limit switch controlled compact fluorescent lighting (CFL) | -Yes/No | Yes |  |
|  | Terminal blocks | Yes/No | Yes |  |
|  | Phase/pole discrepancy timer relay | Yes No | No |  |
|  | Standard British type power socket outlet | Yes/No | Yes |  |
| 35 | Mounting brackets and hardware | Yes/No | Yes |  |
|  | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | Date of issue |  | Yes |  |
|  | Validity |  | Latest |  |
|  | Certificate attached to the offer | Yes/No | Yes |  |
| 36 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
|  | Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 37 | Standards | - | IEC 62271, IEC 60056  ,IEC 60694 |  |
| 38 | Installation | - | Outdoor, desert/tropical environment |  |

## 145 kV,2000A, 31.5kA-3 sec, DISCONNECT SWITCH

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type designation |  | Horizontal Centre break |  |
| 3 | Type of operating mechanism |  | DC Motor |  |
| 4 | Model no |  |  |  |
| 5 | Country of origin |  |  |  |
| 6 | Number of poles | - | 3 |  |
| 7 | Rated current | A | 2000 |  |
| 8 | Short time current withstand during | kA  s | 31.5  3 |  |
| 9 | Creep age distance | mm/kV | 31 |  |
| 10 | Installation altitude | M amsl | ≤1000 |  |
| 11 | Maximum capacitive current that can be interrupted by the disconnector switch | A | As per IEC |  |
| 12 | Total time from initiation of opening operation to isolator in fully open position. | s | < 15 |  |
| 13 | Time from contact separation to extinction of capacitive arc | s |  |  |
| 14 | Closing time | s | < 15 |  |
| 15 | Insulator designation (IEC 273) | - |  |  |
| 16 | HV terminals connectors for | - |  |  |
| 17 | Operating mechanism |  | motor and manual |  |
|  | Motor voltage | Vdc | 110 |  |
|  | Nominal control voltage | Vdc | 110 |  |
|  | Number of auxiliary contacts available | - | 10 NO, 10 NC |  |
|  | Main disconnect contacts operated by | - | Motor and manual |  |
|  | Mechanical life of disconnector switch and mechanism in no. of operations |  | 10,000  (M2 class) |  |
| 18 | Mass and dimensions |  |  |  |
|  | Distance between poles | mm |  |  |
|  | Height of a pole | mm |  |  |
|  | Height of the support structure | mm |  |  |
|  | Total height | mm |  |  |
|  | Length of a pole | mm |  |  |
|  | Mass of a pole | kg |  |  |
|  | Mass of the motor mechanism | Kg |  |  |
| 19 | Accessories | Yes/No | Yes |  |
| 20 | Local/Remote selector switch | Yes/No | Yes |  |
| 21 | Automatic isolation of control supplies when lock is off | Yes/No | Yes |  |
| 22 | Accessibility of operating mechanism from ground level | Yes/No | Yes |  |
| 23 | Rated power of operating coil | W |  |  |
| 24 | Rated power of motor | W |  |  |
| 25 | Total load of heaters for isolator | W |  |  |
| 26 | Contact type | - | Silver plated copper |  |
| 27 | Type of interlocking with CB |  | Electrical |  |
| 28 | Thermostat controlled Space heater | Yes/No | Yes |  |
| 29 | Local manual and electrical operation devices | - | Yes |  |
| 30 | Automatic isolation of control circuit/supply upon loss of motor supply | Yes/No | Yes |  |
| 31 | Light, heater and service plug in operating mechanism enclosure | Yes/No | Yes |  |
| 32 | Cubicle light to be compact fluorescent light (CFL) type with door limit switch control | Yes/No | Yes |  |
| 33 | MCB protected motor and control circuits | Yes/No | Yes |  |
| 34 | Overload relay (OLR) for motor protection | Yes/No | Yes |  |
| 35 | Motor contactor | - | Yes |  |
| 36 | Terminal blocks | Yes/No | Yes |  |
| 37 | Weatherproof corrosion resistant enclosure | - | IP 65 |  |
| 38 | Mounting brackets and hardware | Yes/No | Yes |  |
| 39 | Arcing horns | - |  |  |
| 40 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
|  | Date of issue |  | Latest |  |
|  | Validity | Yes/No | Yes |  |
|  | Quality Certificate attached to bid document | Yes/No | Yes |  |
| 41 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
|  | Certificate/drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 42 | Standards |  | IEC 62271, IEC60129,  IEC 60273,  IEC 60694,  IEC 60815,  IEC 60947 |  |

## 

## 145 kV,2000A, 31.5kA-3 sec, DISCONNECT SWITCH

With One or Two Earthing blades

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer | - |  |  |
| 2 | Type designation | - | Horizontal center break |  |
| 3 | Type of operating mechanism |  | DC Motor |  |
| 4 | Model no | - |  |  |
| 5 | Country of origin | - |  |  |
| 6 | Number of poles | - | 3 |  |
| 7 | Rated current | A | 2000 |  |
| 8 | Short time current with stand ability during | kA s | 31.5 3 |  |
| 9 | Creep age distance | mm/kV | 31 |  |
| 10 | Total time from initiation of opening operation to isolator in fully open position. | s | < 15 |  |
| 11 | Time from contact separation to extinction of capacitive arc | S |  |  |
| 12 | Closing time | s | < 15 |  |
| 13 | Insulator designation (IEC 273) | - |  |  |
| 14 | Grounding switch rated inductive (electromagnetic) breaking current at breaking voltage | A kV |  |  |
| 15 | Grounding switch rated capacitive (electrostatic) breaking current at breaking voltage | A kV |  |  |
| 16 | HV terminals connectors for | - | TBA |  |
| 17 | Operating mechanism |  | Motor and Manual |  |
| 18 | Motor opearting voltage | Vdc | 110 |  |
| 19 | Number of auxiliary contacts available | - | 10 NO, 10 NC |  |
| 20 | Main disconnector contact operated by | - | Motor and Manual |  |
| 21 | Mechanical life of disconnector switch and mechanism in no. of operations |  | 10,000  (M2 class) |  |
| 22 | Mass and dimensions |  |  |  |
|  | Distance between poles | mm |  |  |
|  | Height of a pole | mm |  |  |
|  | Height of the support structure | mm |  |  |
|  | Total height | mm |  |  |
|  | Length of a pole | mm |  |  |
|  | Mass of a pole | kg |  |  |
|  | Mass of the motor mechanism | kg |  |  |
| 23 | Accessories | Yes/No | Yes |  |
| 24 | Local/Remote selector switch | - | Yes |  |
| 25 | Local manual and electrical operation devices | Yes/No | Yes |  |
| 26 | Light, heater and service plug in operating mechanism enclosure | Yes/No | Yes |  |
| 27 | Cubicle light to be compact fluorescent light (CFL) type with door limit switch control | Yes/No | Yes |  |
| 28 | Automatic isolation of control circuit/supply upon loss of motor supply | Yes/No | Yes |  |
| 29 | Interlocking magnet/coil with line voltage | Yes/No | Yes |  |
| 30 | MCB protected motor and control circuits | Yes/No | Yes |  |
| 31 | Overload relay (OLR) for motor protection | Yes/No | Yes |  |
| 32 | Motor contactor | Yes/No | Yes |  |
| 33 | Terminal blocks | - | Yes |  |
| 34 | Weatherproof corrosion resistant enclosure | - | IP 65 |  |
| 35 | Mounting brackets and hardware | - | Yes |  |
| 36 | Interlock between DS and Earth switch | - | Electrical and mechanical |  |
| 37 | Interlock between DS and circuit breaker |  | Electrical |  |
| 38 | Arcing horns | - | Yes |  |
| 39 | Contact type |  | Silver plated copper |  |
| 40 | Total load of heaters for isolator and earths witch | W |  |  |
| 41 | Rated power of motor | W |  |  |
| 42 | Rated power of operating coil | W |  |  |
| 43 | Thermostat controlled Space heater | Yes/No | Yes |  |
| 44 | Nominal heater voltage | VAC | 240 |  |
| 45 | Standards |  | IEC 62271, IEC60129, IEC 60273, IEC 60694, IEC 60815, IEC 60947 |  |

## 145 kV BUS SUPPORT INSULATOR

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer | - |  |  |
| 2 | Type | - |  |  |
| 3 | Material | - | Brown Glazed Porcelain |  |
| 4 | Country origin | - |  |  |
|  | Nominal characteristics |  |  |  |
| 5 | Rated maximum voltage | kV | 145 |  |
| 6 | Lightning impulse withstand voltage (BIL) | kV | 650 |  |
| 7 | Power frequency withstand voltage (wet condition) | kV | 275 |  |
| 8 | Creep age distance | mm/kV | 31 |  |
| 9 | Radio influence voltage data (IEC60694): |  |  |  |
| 10 | * test voltage | kV | 145 |  |
| 11 | * max. RIV | µV | 2500 |  |
| 12 | Cantilever strength: | KN | min. 14kN |  |
| 13 | Insulator’s designation (IEC60273) | - | - |  |
| 14 | Weight and dimensions |  |  |  |
|  | Diameter | mm |  |  |
|  | Height | mm |  |  |
|  | Base bolt circle | mm |  |  |
|  | Cap bolt circle | mm |  |  |
|  | Base bolt size | mm |  |  |
|  | Cap bolt size | mm |  |  |
|  | Weight | kg |  |  |
| 15 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
|  | Date of issue |  | Latest |  |
|  | Validity | Yes/No | Yes |  |
|  | Quality Certificate attached to bid document | Yes/No | Yes |  |
| 16 | Test reports/ drawings/catalogs to be attached to the offer |  |  |  |
| 17 | Standards |  | IEC 60273.IEC 60694, IEC 60815 |  |
| 18 | Installation |  | Outdoor |  |

## 120kV, 10kA, CLASS-3, SURGE ARRESTER WITH DISCHARGE COUNTER

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - |  |  |
| 3 | Model | - |  |  |
| 4 | Country of origin | - |  |  |
|  | Nominal characteristics |  |  |  |
| 5 | Line discharge class (IEC 99-4) | - | 3 |  |
| 6 | Protection characteristics |  |  |  |
| 7 | Max. residual voltages |  |  |  |
| 8 | for a steep impulse current, 1 μs front, 10 kA | kV | 406 |  |
| 9 | for a lightning impulse current, 8/20 μs, 10 kA | kV | 511 |  |
| 10 | for a switching impulse current,  30/60 μs, 0,5 kA | kV | 306 |  |
| 11 | Energy dissipation capacity |  | >7 |  |
|  | Operating performances |  |  |  |
| 12 | High current impulse withstand   (4/10 μs) | kA | 100 |  |
| 13 | Temporary over voltage withstand (for 10 s) | kV | 120 |  |
| 14 | Line discharge current withstand: |  |  |  |
|  | * Peak duration | μs | 2400 |  |
|  | * Line characteristic impedance | ohms | 156 |  |
|  | * Charging voltage (peak value) | kV | 336 |  |
| 15 | Cantilever strength | kN |  |  |
| 16 | * Torsion strength | N-m |  |  |
| 17 | Pressure relief capacity |  |  |  |
|  | * Current amplitude (rms) | kA | 31.5 |  |
|  | * X/R, asymmetry factor | - | 17 |  |
|  | * Current duration | s | 0.2 |  |
| 18 | External radio interference voltage (RIV) |  | N/A |  |
| 19 | Secondary Circuit Protection |  | MCB |  |
| 20 | Weights and dimensions: |  |  |  |
|  | * arrester height | mm |  |  |
|  | * arrester diameter | mm |  |  |
|  | * weight | kg |  |  |
| 21 | Accessories |  |  |  |
|  | Mounting hardware | - | Yes |  |
|  | Ground connector | - | Yes |  |
|  | Insulating bases | - | Yes |  |
|  | Discharge counter model | - | Yes |  |
|  | HV terminals connectors for | - |  |  |
| 22 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
|  | Date of issue |  | Latest |  |
|  | Validity | Yes/No | Yes |  |
|  | Quality Certificate attached to bid document | Yes/No | Yes |  |
| 23 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
|  | Certificate/ drawings/catalogs to be attached to the offer | Yes/No | Yes |  |
| 24 | Standards | - | IEC 60099 |  |
| 25 | Installation | - | Outdoor |  |

## 132 kV CAPACITOR VOLTAGE TRANSFORMER –CVT1

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - |  |  |
| 3 | Model no | - |  |  |
| 4 | Capacitance C1 and C2 | pf | 4400 |  |
| 5 | Series reactor |  |  |  |
|  | inductance range | mH | - |  |
|  | resistance range | ohms | - |  |
| 6 | Transformation ratio  Power frequency withstand voltage (1 min) | - | 132kV/√3  : 0,11kV/√3  : 0,11kV/√3  : 0,11kV/√3 |  |
| 7 | Transformer characteristics |  |  |  |
|  | HV/LV turn ratio range |  |  |  |
|  | Normal operating flux density |  |  |  |
| 8 | Primary voltage |  | 132/√3 |  |
| 9 | Secondary voltage |  | 110/√3 |  |
| 10 | Winding accuracy: |  |  |  |
|  | - class |  | 3P/100VA |  |
|  | - class |  | 3P/100VA |  |
|  | - class |  | 0.2/50VA |  |
| 11 | Number of secondary windings |  | 3 |  |
| 12 | Secondary winding cubicle |  | IP 65 |  |
| 13 | Winding conductor | - | Cu |  |
| 14 | Circuit Diagram | - |  |  |
| 15 | HV Terminal Connector for terminal Connector | - |  |  |
| 16 | Weights and Dimensions | Kg/mm |  |  |
|  | Weight for operation | kg |  |  |
|  | Weight for transport | kg |  |  |
|  | Height | m |  |  |
|  | Shipping dimensions (H x W x D) | m |  |  |
| 17 | Outline drawing number/ catalogs |  |  |  |
| 18 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
|  | Date of issue |  | Latest |  |
|  | Validity | Yes/No | Yes |  |
|  | Quality Certificate attached to bid document | Yes/No | Yes |  |
| 19 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
| 20 | Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 21 | Standards |  | IEC61869, IEC60186 |  |
| 22 | Installation |  | Outdoor, in substation switchyard, Tropical condition |  |

## 132 kV CAPACITOR VOLTAGE TRANSFORMER -CVT2

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - |  |  |
| 3 | Model no. | - |  |  |
|  | Nominal characteristics |  |  |  |
| 4 | Capacitance C1 and C2 | pf | 4400 |  |
| 5 | Series reactor |  |  |  |
| 6 | * inductance range | mH | - |  |
| 7 | * resistance range | ohms | - |  |
| 8 | Transformation ratio | - | 132kV/√3  : 0,11kV/√3  : 0,11kV/√3  : 0,11kV/√3 |  |
| 9 | Transformer characteristics |  |  |  |
| 10 | HV/LV turn ratio range |  |  |  |
| 11 | Normal operating flux density |  |  |  |
| 12 | Primary voltage |  | 132/√3 |  |
| 13 | Secondary voltage |  | 110/√3 |  |
| 14 | Winding accuracy: |  |  |  |
|  | 0.2/50VA; 0.2/50VA; 3P/100VA |  |  |  |
|  | burden (simultaneous on each winding) 50/50/100 VA |  |  |  |
| 15 | Number of secondary windings |  | 3 |  |
| 16 | Winding conductor | - | Cu |  |
| 17 | Secondary terminal cubicle |  | IP 65 |  |
| 18 | Circuit Diagram | - |  |  |
| 19 | HV Terminal Connector for terminal Connection | - |  |  |
| 20 | Secondary Circuit Protection |  | MCB |  |
| 21 | Weights and Dimensions |  |  |  |
|  | Weight for operation | kg |  |  |
|  | Weight for transport | kg |  |  |
|  | Height | m |  |  |
|  | Shipping dimensions (H x W x D) | m |  |  |
|  | Outline drawing number/ catalogs |  |  |  |
| 22 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
| 23 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | Yes/No | Yes |  |
| 24 | Standards |  | IEC61869, IEC60186 |  |
| 25 | Installation |  | Outdoor, in substation switchyard, Tropical condition |  |

## 132kV CURRENT TRANSFORMER (OHL feeders)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Oil |  |
| 3 | Model no | - |  |  |
| 4 | Rated current | A | 800-400-200 |  |
| 5 | Primary rated currents OHL feeders | A | 800-400-200 |  |
| 6 | Secondary rated currents | A | 1 |  |
| 7 | Number of Cores  OHL feeders | NO | 4 |  |
| 8 | Accuracy class, Burden: |  |  |  |
|  | Core I | - | 5P20, 20VA |  |
|  | Core II | - | 5P20, 20VA |  |
|  | Core III |  | 0.2S |  |
|  | Core IV |  | 0.2S |  |
| 9 | Winding conductor | - | Cu |  |
| 10 | Class | - | To be enclosed with bid/SLD |  |
| 10.1 | Transient performance |  |  |  |
|  | rated S.C. current factor | p.u. |  |  |
|  | primary time constant | ms |  |  |
|  | secondary C.T. time constant | ms |  |  |
|  | Duty cycle | - |  |  |
|  | resistive burden | ohms |  |  |
|  | secondary C.T. resistance | ohms |  |  |
|  | transient dimensioning factor | - |  |  |
|  | remanence factor | - |  |  |
|  | equivalent limiting secondary EMF saturation curve | V |  |  |
| 12 | HV Terminal Connector for | - | TBA/ To be enclosed with bid |  |
| 13 | LV Terminal Voltage Limiting Device | - | YES/ To be enclosed with bid |  |
| 14 | Weights and Dimensions |  |  |  |
|  | Weight for operation | Kg | - |  |
|  | Weight for transport | Kg |  |  |
|  | Height | m |  |  |
| 15 | Shipping dimensions (H x W x D) | M |  |  |
| 16 | Outline drawing number/catalogs | - |  |  |
| 17 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
| 18 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | - |  |  |
| 19 | Standards | - | IEC 61869, IEC 60044,IEC 60694,IEC 60947-1,IEC 60376 |  |
| 20 | Installation | - | Outdoor in substation switchyard, Tropical condition |  |

## 132 kV CURRENT TRANSFORMER (IBT Feeders)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Oil |  |
| 3 | Model no | - |  |  |
| 4 | Rated current | A | 800-400-200 |  |
| 5 | Primary rated currents  OHL feeders | A | 800-400-200 |  |
| 6 | Secondary rated currents | A | 1 |  |
| 7 | Number of Cores  IBT feeders | No | 4 |  |
| 8 | Accuracy class, Burden: |  |  |  |
|  | * Core I | - | 5P20, 20VA |  |
|  | * Core II | - | 5P20, 20VA |  |
|  | * Core III |  | 0.2S |  |
|  | * Core IV |  | 0.2S |  |
|  | * burden metering/protection |  |  |  |
| 9 | * Winding conductor | - | Cu |  |
| 10 | Transient performance |  |  |  |
|  | * Class | - | To be enclosed with bid/SLD |  |
|  | * rated S.C. current factor | p.u. |  |  |
|  | * primary time constant | ms |  |  |
|  | * secondary C.T. time constant | ms |  |  |
|  | * Duty cycle | - |  |  |
|  | * resistive burden | ohms |  |  |
|  | * secondary C.T. resistance | ohms |  |  |
|  | * transient dimensioning factor | - |  |  |
|  | * remanence factor | - |  |  |
|  | * equivalent limiting secondary EMF saturation curve | V |  |  |
| 11 | HV Terminal Connector for | - | TBA/ To be enclosed with bid |  |
| 12 | LV Terminal Voltage Limiting Device | - | YES/ To be enclosed with bid |  |
| 13 | Weights and Dimensions |  |  |  |
|  | Weight for operation | Kg |  |  |
|  | Weight for transport | Kg |  |  |
|  | Height | m |  |  |
| 14 | Shipping dimensions (H x W x D) | M |  |  |
| 15 | Outline drawing number/catalogs | - |  |  |
| 16 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
| 17 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | - |  |  |
| 18 | Standards | - | IEC 61869,  IEC 60044 IEC 60694,  IEC 60947-1,  IEC 60376 |  |
| 19 | Installation | - | Outdoor in substation switchyard  Tropical condition |  |

## 132 kV CURRENT TRANSFORMER -BUS SECTION/BUS COUPLER FEEDERS

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Oil |  |
| 3 | Model no | - |  |  |
| 4 | Rated current | A | 2000-1000-500 |  |
| 5 | Primary rated currents  Bus section/Bus coupler | A | 2000-1000-500 |  |
| 6 | Secondary rated currents | A | 1 |  |
| 7 | Number of cores  Bus section/Bus coupler | - | 2 |  |
| 8 | Accuracy class, Burden: |  |  |  |
|  | Core I | - | 5P20, 20VA |  |
|  | Core II | - | 5P20, 20VA |  |
| 9 | Winding conductor | - | Cu |  |
| 10 | Transient performance |  |  |  |
|  | Class | - |  |  |
|  | rated S.C. current factor | p.u. |  |  |
|  | primary time constant | ms |  |  |
|  | secondary C.T. time constant | ms |  |  |
|  | Duty cycle | - |  |  |
|  | resistive burden | ohms |  |  |
|  | secondary C.T. resistance | ohms |  |  |
|  | transient dimensioning factor | - |  |  |
|  | remanence factor | - |  |  |
|  | equivalent limiting secondary EMF saturation curve | V |  |  |
| 11 | * HV Terminal Connector for | - | TBA/ To be enclosed with bid |  |
| 12 | LV Terminal Voltage Limiting Device | - | YES/ To be enclosed with bid |  |
| 13 | * Weights and Dimensions |  |  |  |
|  | Weight for operation | Kg |  |  |
|  | Weight for transport | Kg |  |  |
|  | Height | m |  |  |
| 14 | Shipping dimensions (H x W x D) | M |  |  |
| 15 | Outline drawing number/catalogs | - |  |  |
| 16 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
| 17 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | - |  |  |
| 18 | Standards | - | IEC 61869  IEC 60044 IEC 60694  IEC 60947-1 IEC 60376 |  |
| 19 | Installation | - | Outdoor in substation switchyard  Tropical condition |  |

## 132 kV LOW POWER INSTRUMENT TRANSFORMER LPIT –OHL FEEDER

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Optical current sensor |  |
| 3 | Model no | - |  |  |
| 4 | Rated current | A | 50 up to 2500 |  |
| 4.12.5 | Short-circuit current capability (1 s) | KA | 63 |  |
| 6 | Accuracy class |  | IEC 5P,  IEEE 5TPE |  |
| 7 | Seismic capability | g | 0.5 |  |
| 8 | Dynamic range | % | <2% at 100kA |  |
| 9 | Bandwidth | - | 0.5 to 6 kHz |  |
| 10 | Weights and Dimensions |  |  |  |
|  | Weight for operation | Kg | <45 |  |
|  | Weight for transport | Kg |  |  |
|  | Height | m | < 1 |  |
| 11 | Shipping dimensions (H x W x D) | M |  |  |
| 12 | Outline drawing number/catalog | - |  |  |
| 13 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | YES |  |
| 14 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted. Type test will not be issued before 5 years | - |  |  |
| 15 | Standards | - | IEC 61869,  IEC 60044 IEC 60694,  IEC 60947,  IEC 60376 |  |
|  | Installation | - | Outdoor in substation switchyard  Tropical condition |  |
| 16 | Electronic Unit (MU) |  |  |  |
|  | Power Input | Vdc | 70-150 |  |
|  | Input Interface | - | Standardized Fiber Optic |  |
|  | Output Interface |  | 1000Base-FX |  |
|  | Output protocol SV | - | IEC61850-9-2LE or IEC61869-9 |  |
|  | Other Output protocol and Management |  | IEC61850 Client/Server |  |
|  | Network redundancy | - | IEC 62439 – PRP |  |
|  | Clock Synchronization | - | IEC/IEEE 61850-9-3:2016 - Power Utility Profile |  |
|  | Holdover time | seg | 30 |  |
|  | Maximum ambient temperature | °C | 40 (indoor) |  |

## 132 kV,2000A, 31.5kA-3sec, BUSBAR

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type | - | Tubular |  |
| 3 | Catalogue No. | - |  |  |
| 4 | Country of origin | - |  |  |
| 5 | Characteristics | - |  |  |
|  | Material | - | Aluminum/ Aluminium alloy |  |
|  | Designation | - |  |  |
|  | Conductivity (% IACS) | % | 53 min |  |
|  | Resistance at 20 oC | Ω |  |  |
| 6 | Normal current rating |  |  |  |
|  | at 40oC | A | 2000 |  |
|  | at 50oC | A | 2000 |  |
| 7 | Exterior diameter | mm | 114.3 |  |
| 8 | Interior diameter | mm | 102.26 |  |
| 9 | Section | mm2 |  |  |
| 10 | Bar section length | m |  |  |
| 11 | Linear weight | kg/m | 5.6 approx |  |
| 12 | Maximum span | m |  |  |
| 13 | Transportation |  |  |  |
|  | Number of tubes per crate | - |  |  |
|  | Dimensions of crate | mm |  |  |
|  | Weight of crate | mm |  |  |
| 14 | Standards | - | IEC 60105 ASTM B317 ANSI H35.2 |  |
| 15 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
| 16 | Installation | - | Outdoor |  |

## 132 kV,2000A, 31.5kA-3sec STRAIN BUSBAR CONDUCTOR

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type |  |  |  |
| 3 | Code Name | - | Aster 570 |  |
| 4 | Designation | - |  |  |
| 5 | Country of Origin | - |  |  |
|  | Mechanical characteristics and dimensions |  |  |  |
| 6 | Stranding | - | 61 |  |
| 7 | Aluminium wire diameter | mm | 3.45 |  |
| 8 | Overall diameter | mm | 31.05 |  |
| 9 | Aluminium area | mm2 |  |  |
| 10 | Nominal área | mm2 | 570,22 |  |
| 11 | Rated current | A | 1080 |  |
| 12 | Mass | kg/km | 1576 |  |
| 13 | Rated tensile strength | KN | 185.33 |  |
| 14 | Initial lower modulus of elasticity | GPa |  |  |
| 15 | Initial upper modulus of elasticity | GPa |  |  |
| 16 | Transition stress | MPa |  |  |
| 17 | Final modulus of elasticity | GPa |  |  |
| 18 | Creep modulus at 15ºC | GPa |  |  |
| 19 | Coefficient of linear thermal expansion | E-6/ºC |  |  |
| 20 | D.C. resistance at 20ºC | ohms/km | 0.0583 |  |
| 21 | Transport |  |  |  |
|  | Standard length of conductor per reel | m |  |  |
|  | Maximum number of standard lengths per reel |  |  |  |
|  | Flange Diameter | mm |  |  |
|  | Inside traverse | mm |  |  |
|  | Overall width | mm |  |  |
|  | Drum Diameter | mm |  |  |
|  | Minimum cover from edge of flange | mm |  |  |
|  | Arbor hole diameter | - |  |  |
|  | Material | mm |  |  |
|  | Empty reel mass | Kg |  |  |
|  | Thickness of lagging | mm |  |  |
|  | Shipping mass | kg |  |  |
|  | Shipping volume | m3 |  |  |
| 22 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
| 23 | Standards |  | IEC 60889 |  |
| 24 | Installation | - | Outdoor |  |

## 132 kV,2000A, 31.5kA-3 sec BUSBAR CONNECTORS AND HARDWARE

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | **M**anufacturer |  |  |  |
| 2 | Country of origin | - |  |  |
| 3 | Characteristics |  |  |  |
| 4 | Sizes of bus conductors: |  |  |  |
|  | rigid 132 kV busses |  | 100 mm min. |  |
|  | flexible conductor |  | ASTER 570 mm2 |  |
| 5 | Rated current | A | 2000 |  |
| 6 | Resistance vs resistance of the conductor | % |  |  |
| 7 | Radio influence voltage (IEC 60694) at 140 % rated voltage at 0.5 MHz | µV |  |  |
| 8 | Frequency | Hz | 50 |  |
| 9 | Connectors type (non-limitative) |  |  |  |
|  | Shielding rings | - |  |  |
|  | bus support | - |  |  |
|  | bus flexible support | - |  |  |
|  | rigid-flexible connectors | - |  |  |
|  | angle A, Y connectors | - |  |  |
|  | T connectors | - |  |  |
|  | Expansion connectors | - |  |  |
|  | pad connectors | - |  |  |
|  | union connectors | - |  |  |
|  | Caps | - |  |  |
| 10 | Material of connectors | - | Aluminium Alloy |  |
| 11 | Conductivity (IACS) | % | 35 min. |  |
| 12 | Short-circuit withstand | kA | 31.5 for 3Sec |  |
| 13 | Various bolt size used for: |  |  |  |
|  | 132 kV bus bars | mm |  |  |
|  | Conductors for 132 kV | mm |  |  |
|  | Material of bolts | mm | AL 7075T73 or equiv./ To be enclosed with bid |  |
| 14 | Tightening torque for bolts |  |  |  |
|  | size and torque – bolt #1 | - |  |  |
|  | size and torque – bolt #2 | - |  |  |
|  | size and torque – bolt #3 | - |  |  |
|  | size and torque – bolt #4 | - |  |  |
|  | size and torque – bolt #5 | - |  |  |
| 15 | Resistance to traction |  |  |  |
|  | connector on stranded conductor | - | 10 % of conductor |  |
|  | connector on tube | KN |  |  |
| 16 | Strength of bus support |  |  |  |
|  | stranded conductor (long., vert., trans.) | KN | 18, 9, 9/ To be enclosed with bid |  |
|  | bus tube (long., vert., trans.) | KN | 2, 9, 18/ To be enclosed with bid |  |
| 17 | Tests |  |  |  |
|  | cyclic heat run test | - | YES |  |
|  | short circuit current withstands | - | YES |  |
|  | mechanical strength | - | YES |  |
|  | resistance to traction | - | YES |  |
|  | bolts over-tightening resistance | - | YES |  |
|  | radio interference | - | YES |  |
|  | routine dimensions check | - | YES |  |
|  | chemical analysis of material | - | YES |  |
|  | radiography test | - | YES |  |
| 18 | Weight and dimension |  |  |  |
|  | Average weight of item | kg |  |  |
|  | Average packing dimension | mm |  |  |
|  | Number of items per crate | - |  |  |
|  | Dimensions of crate | mm |  |  |
|  | Weight of crate | kg |  |  |
| 19 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
| 20 | Standards |  | NEMA CC-1, ANSI C119.4,  ASTM B26/B26M, ASTM B108, ASTM B193, ASTM E155 |  |
| 21 | Installation |  | Outdoor |  |

## 145 kV TENSION/suspension INSULATORS(longrod)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| 1 | Manufacturer |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Insulator material |  | Silicone rubber |  |
| 4 | Coupling |  | Ball and socket |  |
| 5 | Colour/Surface |  | Grey/Smooth |  |
| 6 | Housing |  | Single mold |  |
| 7 | Ball and socket diameter | mm |  |  |
| 8 | Min. creepage distance | mm | 4500 |  |
| 9 | Maximum working load | KN | 160 |  |
| 10 | Outside diameter |  |  |  |
| 11 | Number of sheds |  |  |  |
| 10 | Power frequencies withstand voltage of complete string | KV | 275 |  |
| 11 | Rated lightning Impulse withstand voltage | kVp | 650 |  |
| 12 | Visual corona discharge voltage | kVrms |  |  |
| 13 | Radio influence voltage measured at 1.1 times Us/√3 at 1 MHz | µv | 50 |  |
| 14 | Total length with hardware | mm |  |  |
| 15 | Manufacturer quality system in accordance with ISO 9000 | Yes/No |  |  |
|  | * Date of issue |  | Yes |  |
|  | * Validity |  | Latest |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 16 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted not older than 5 years | Yes/No | Yes |  |
| 17 | * Certificate/ drawings/catalogs to be attached to the offer to be attached to the offer | Yes/No | Yes |  |
| 18 | * Standards |  | IEC 61109  IEC 60372  IEC 60120 |  |

# 75/90/10MVA; YNyn0d11; 400/132/11kV THREE WINDING TRANSFORMERS (AIS)

| **S.No.** | **Description** | **Unit** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Type |  |  |  |
|  | * Three phase, three winding transformer, oil-immersed, core type with tertiary winding | Yes/No | Yes |  |
| 4 | Ambient temperature (Zone 1 – within IEC reference values, e.g. inland at altitude) |  |  |  |
|  | * Maximum | °C | 45 |  |
|  | * Average of hottest month | °C | 40 |  |
|  | * Annual average | °C | 35 |  |
| 5 | Ambient temperature (Zone 2 – within IEC reference values, e.g. Coastal with high annual average) | C |  |  |
|  | * Maximum | °C | 45 |  |
|  | * Average of hottest month | °C | 35 |  |
|  | * Annual average | °C | 30 |  |
| 6 | Mounting |  | Outdoor |  |
| 7 | Rated voltage ratio (HV/LV/TV) | kV | 400/132/11 |  |
| 8 | Rated frequency | Hz | 50 |  |
| 9 | Vector group |  | YNyn0d11 |  |
| 10 | Cooling |  | ONAN/ONAF |  |
|  | %Z (Impedance) | % | 14 |  |
| 11 | Function of tertiary winding (TV) |  | Aux. supply |  |
| 12 | Method of earthing |  |  |  |
|  | * HV winding |  | Solid |  |
|  | * LV winding |  | Solid |  |
|  | * TV winding |  | Grounded via earthing transformer |  |
| 13 | Type of windings (graded/non-graded) |  |  |  |
|  | * HV winding |  | Graded |  |
|  | * LV winding |  | Graded |  |
|  | * TV winding |  | Un-Graded |  |
| 14 | Rated voltage of windings (Ur) |  |  |  |
|  | * HV winding | kV | 400 |  |
|  | * LV winding | kV | 132 |  |
|  | * TV winding | kV | 11 |  |
| 15 | Highest voltage for equipment (Um) |  |  |  |
|  | * HV winding | kV | 420 |  |
|  | * LV winding | kV | 145 |  |
|  | * TV winding | kV | 12 |  |
| 16 | Rated lightning impulse withstand voltage (at altitude <1000m): |  |  |  |
|  | * HV terminal -400kv | kV | 1425 |  |
|  | * LV terminal – 132kv | kV | 650 |  |
|  | * Neutral terminal -400kv | kV | 125 |  |
|  | * Neutral terminal – 132kv | kV | 125 |  |
|  | * TV winding | kV | ≥95 |  |
| 17 | Rated switching impulse voltage (at altitude <1000m) | Phase to earth |  |  |
|  | * HV terminal | kV | 1175 |  |
|  | * LV terminal | kV | 540 |  |
| 18 | Rated power frequency withstand voltage (at altitude <1000m) |  |  |  |
|  | * HV terminal (design value only) | kV | 630 |  |
|  | * LV terminal (Design value) | kV | 275 |  |
|  | * Neutral terminal - HV | kV | 50 |  |
|  | * Neutral terminal - LV | kV | 50 |  |
|  | * TV terminal | kV | ≥28 |  |
| 19 | Rated power at site conditions (ONAF1/ONAF2) | MVA | 90 |  |
| 20 | Rated power at site conditions (ONAN) | MVA | 75 |  |
| 21 | Rated power of tertiary at site conditions (Full cooling) | MVA | 10 |  |
| 22 | Maximum temperature rises at rated power at (IEC shown, Zone 1): |  |  |  |
|  | * Windings | K | 65 |  |
|  | * Hot spot of windings | K | 78 |  |
|  | * Top oil | K | 60 |  |
|  | * Oil at inlet of cooler | K |  |  |
|  | * Oil at outlet of cooler | K |  |  |
|  | * Core | K |  |  |
| 23 | Maximum temperature rise at rated power at (IEC shown, Zone 2): |  |  |  |
|  | * Windings | K | 50 |  |
|  | * Hot spot of windings | K | 68 |  |
|  | * Top oil | K | 55 |  |
|  | * Oil at inlet of cooler | K |  |  |
|  | * Oil at outlet of cooler | K |  |  |
|  | * Core | K |  |  |
| 24 | Temperature of winding due to short circuit duration of 2s at rated load |  |  |  |
|  | * HV side short circuit rating of 40kA | °C | 250 |  |
|  | * LV side short circuit rating of 31.5 kA | °C | 250 |  |
| 25 | Minimal value of maximum efficiency at rated power | % |  |  |
| 26 | No-load losses at rated voltage and rated frequency | kW | 45(Max) |  |
| 27 | Load losses at 75°C and rated frequency: |  |  |  |
|  | * ONAF rated power (90MVA) and principal tapping- to be proved by test and calculation | kW | 240 (Max) at 90MVA Base |  |
|  | * ONAN rated power (75MVA) and principal tapping- to be proved and calculation | kW | 180 (Max) 75 MVA Base |  |
| 28 | Total auxiliary losses at full load | kW |  |  |
| 29 | Maximum current density at rated power: |  |  |  |
|  | * HV (Series) winding | A/mm2 |  |  |
|  | * LV (Common) winding | A/mm2 |  |  |
|  | * TV winding | A/mm2 |  |  |
|  | * Tapping | A/mm2 |  |  |
| 30 | Symmetrical short circuit through current (duration 2 s) at system fault rating |  |  |  |
|  | * HV terminals (40 kA) | kA |  |  |
|  | * LV terminals (31.5 kA) | kA |  |  |
| 31 | Magnetising current (HV winding) |  |  |  |
|  | * At 90% rated voltage | A |  |  |
|  | * At 100% rated voltage | A |  |  |
|  | * At 110% rated voltage | A |  |  |
| 32 | Maximum flux density in iron at rated voltage, power frequency and principal tapping: |  |  |  |
|  | * Wound limbs | T |  |  |
|  | * Unwound limbs | T |  |  |
|  | * Yokes | T |  |  |
|  | * Shields | T |  |  |
| 33 | Maximum flux density in iron at power frequency, principal tapping and 105% rated voltage: |  |  |  |
|  | * Wound limbs | T |  |  |
|  | * Unwound limbs | T |  |  |
|  | * Yokes | T |  |  |
|  | * Shields | T |  |  |
| 34 | Type of tap changing |  | OLTC, Vacuum |  |
| 35 | Manufacturer of on-load tap changer |  | MR. Germany |  |
| 36 | Type designation of on-load tap changer |  |  |  |
| 37 | OLTC location (Provisional) |  | HV side |  |
| 38 | Type of flux voltage variation |  | C.F.V.V |  |
| 39 | Tapping range (Provisional) |  | +10%/-10% |  |
| 40 | Tapping step |  | 1.25% |  |
| 41 | Number of steps (positions) |  | 16 (17) |  |
| 42 | Arrangement of tapping’s (Linear, Coarse/Fine, Reversing) |  |  |  |
| 43 | Automatic voltage control | Yes/No | Yes |  |
|  | * Manufacturer |  |  |  |
|  | * Type reference |  |  |  |
|  | * Controller design (microprocessor-based, numerical) | Yes/No | Yes |  |
|  | * Auxiliary voltage range (V n = 110Vdc) | V dc | 88→150 |  |
|  | * Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | * Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | * Binary Inputs | Yes/No | Yes |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | V dc | 110 |  |
|  | * Maximum permissible voltage | V dc | 150 |  |
|  | * Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | * CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A |  |  |
|  | * Power consumption | VA |  |  |
|  | * VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Parallel operation | Yes/No | Yes |  |
|  | * Power consumption | VA |  |  |
|  | * PC based configuration software for settings | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at controller (e.g. RS232, Ethernet) |  |  |  |
|  | * Communications |  |  |  |
|  | * Communication ports (Front/rear etc.) |  |  |  |
|  | * Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | * Protocol IEC 61850 | Yes/No | Yes |  |
|  | * Type test certificate provided | Yes/No | Yes |  |
| 44 | Impedance voltage range at 75°C, rated frequency and full rating |  |  |  |
|  | * At principal tapping |  | 14% |  |
|  | * At maximum voltage ratio |  | 14% |  |
|  | * At minimum voltage ratio |  | 14% |  |
| 45 | Resistance of winding at 75°C and principal tapping: |  |  |  |
|  | * HV side | Ω/phase |  |  |
|  | * LV side | Ω/phase |  |  |
| 46 | Terminal connection |  |  |  |
|  | * HV terminal |  | Outdoor bushing |  |
|  | * LV terminal |  | Outdoor bushing |  |
|  | * Neutral terminal |  | Outdoor bushing |  |
|  | * TV terminal |  | Outdoor bushing |  |
| 47 | Bushing Creepage Distance (IEC class IV = 31mm/kV) |  |  |  |
|  | * HV terminal (420 kV) | mm | ≥13020 |  |
|  | * LV terminal (145kV) | mm | ≥4495 |  |
|  | * TV terminal (12 kV) | mm | ≥372 |  |
| 48 | Cable box insulation |  |  |  |
|  | * HV terminal |  |  |  |
|  | * LV terminal |  |  |  |
|  | * HV neutral terminal |  |  |  |
|  | * LV neutral terminal |  | Air-filled cable box |  |
| 49 | Isolating links for test purposes |  |  |  |
|  | * HV terminal |  |  |  |
|  | * LV terminal |  |  |  |
|  | * Tertiary earthing terminal |  |  |  |
| 50 | Current transformers  Note: CT data need to be confirmed by contractor’s calculation |  |  |  |
| 51 | HV / LV -Bushing turrets |  |  |  |
|  | * Number of cores |  | Three |  |
|  | * Rated extended primary current |  | 120% |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | * Change of CT ratio shall be possible at the secondary circuit only | Yes/No | Yes |  |
|  | * I core (HV) * I core (LV) | A | 400-200/1  1000-500-250/1 |  |
|  | * II core (HV) * II core (LV) | A | 400-200/1  1000-500-250/1 |  |
|  | * III core (HV) * III core (LV) | A | 400-200/1  1000-500-250/1 |  |
|  | * Class |  |  |  |
|  | * I core (HV) * I core (LV) |  | 5P20/50VA  5P20/50VA |  |
|  | * II core (HV) * II core (LV) |  | 5P20/50VA  5P20/50VA |  |
|  | * III core (HV) * III core (LV) |  | 5P20/50VA  5P20/50VA |  |
|  | * Knee point voltage (Ek) |  |  |  |
|  | * I core (HV) * I core (LV) | V |  |  |
|  | * II core (HV) * II core (LV) | V |  |  |
|  | * III core (HV) * III core (LV) | V |  |  |
|  | * Exciting current (IE ) at Ek |  |  |  |
|  | * I core (HV) * I core (LV) | mA |  |  |
|  | * II core (HV) * II core (LV) | mA |  |  |
|  | * III core (HV) * III core (LV) | mA |  |  |
|  | * Rated output (Burden to be 25-100% rated burden) |  |  |  |
|  | * I core (HV) * I core (LV) | VA | 50 |  |
|  | * II core (HV) * II core (LV) | VA | 50 |  |
|  | * III core(HV) * III core (LV) | VA | 50 |  |
| 52 | Delta Current CTs |  |  |  |
|  | * Number of cores |  | Two |  |
|  | * Rated extended primary current |  | 120% |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | * I core | A | 1000-500-250/1A |  |
|  | * II core | A | 500/1 |  |
|  | * Class |  |  |  |
|  | * I core |  | 5P20 |  |
|  | * II core |  | PX |  |
|  | * Knee point voltage (Ek) |  |  |  |
|  | * I core | V |  |  |
|  | * II core | V |  |  |
|  | * Exciting current (IE ) at Ek |  |  |  |
|  | * I core | mA |  |  |
|  | * II core | mA |  |  |
|  | * Rated output (Burden to be 25-100% rated burden) |  |  |  |
|  | * I core | VA | 50 |  |
|  | * II core | VA | 50 |  |
| 53 | Neutral Turret CTs (HV/LV) |  |  |  |
|  | * Number of cores |  | Two |  |
|  | * Rated extended primary current |  | 120% |  |
|  | * Ratio (TR = turns ratio) | A |  |  |
|  | * Change of CT ratio shall be possible at the secondary circuit only | Yes/No | Yes |  |
|  | * I core (HV) * I core (LV) | A | 500-250/1  1000-500/1 |  |
|  | * II core (HV) * II core (LV) |  | 500-250/1  1000-500/1 |  |
|  | * Class |  |  |  |
|  | * I core (HV) * I core (LV) |  | 5P20  5P20 |  |
|  | * II core (HV) * II core (LV) |  | 5P20  5P20 |  |
|  | * Knee point voltage (Ek) |  |  |  |
|  | * I core (HV) * I core (LV) | V |  |  |
|  | * II core (HV) * II core (LV) | V |  |  |
|  | * Exciting current (IE ) at Ek |  |  |  |
|  | * I core (HV) * I core (LV) | mA |  |  |
|  | * II core (HV) * II core (LV) | mA |  |  |
|  | * Rated output (Burden to be 25-100% rated burden) |  |  |  |
|  | * I core (HV) * I core (LV) | VA | 30  30 |  |
|  | * II core (HV) * Ii core (LV) | VA | 30  30 |  |
|  | All class PX CTs shall have a rated secondary current, ISN | A |  |  |
| 54 | Number of coolers per transformer |  |  |  |
| 55 | Number of stand-by coolers |  |  |  |
| 56 | Number of stand-by fans |  |  |  |
| 57 | Rating of each cooler | kW |  |  |
| 58 | Oil |  |  |  |
|  | * Manufacturer |  | Shell |  |
|  | * Type designation |  | Diala S4 ZX-I or equivalent |  |
|  | * Standards |  | IEC 60296, IEC 62535 |  |
|  | * Minimum flash point | °C |  |  |
|  | * Viscosity |  |  |  |
|  | * at 40°C | mm2/s |  |  |
|  | * at -30°C | mm2/s |  |  |
|  | * at 80°C | mm2/s |  |  |
|  | * Maximum dielectric strength for 1 min. | kV |  |  |
|  | * Dielectric factor |  |  |  |
|  | * Acidity (neutralization value) | mgKOH/g |  |  |
| 59 | Oil preservation system |  | Air-bag |  |
| 60 | Types and arrangement of winding: |  |  |  |
|  | * HV winding |  |  |  |
|  | * LV winding |  |  |  |
|  | * TV winding |  |  |  |
|  | * Regulating |  |  |  |
|  | * Windings arrangement (i.e. core/TV/LV/HV/Taps) |  |  |  |
| 61 | Conductor Material (e.g., copper, work hardened copper, etc.) |  |  |  |
|  | * HV windings |  |  |  |
|  | * LV windings |  |  |  |
|  | * TV windings |  |  |  |
|  | * Regulating windings |  |  |  |
| 62 | Conductor insulation: |  |  |  |
|  | * HV windings |  |  |  |
|  | * LV windings |  |  |  |
|  | * TV windings |  |  |  |
|  | * Connecting leads from winding to tap changer |  |  |  |
| 63 | Calculated thermal time constant |  |  |  |
|  | * ONAN cooling | min |  |  |
|  | * Full cooling | min |  |  |
| 64 | Oil circulation (i.e. natural/partially directed/directed) |  |  |  |
| 65 | To the windings: |  |  |  |
|  | * HV windings |  |  |  |
|  | * LV windings |  |  |  |
|  |  |  |  |  |
|  | * TV windings |  |  |  |
| 66 | Through the windings: |  |  |  |
|  | * HV windings |  |  |  |
|  | * LV windings |  |  |  |
|  |  |  |  |  |
|  | * TV windings |  |  |  |
| 67 | Core construction: |  |  |  |
|  | * Taped/banded/bolted limbs |  |  |  |
|  | * Taped/banded/bolted yokes |  |  |  |
|  | * Taping/banding material |  |  |  |
|  | * Number of limbs |  |  |  |
|  | * Number of limbs wound |  |  |  |
|  | * Type of joint in magnetic core (90% butt, overlap, mitre, etc.) |  |  |  |
|  | * Type of core steel |  |  |  |
|  | * Specific loss of core steel at 1.5 tesla | W/kg |  |  |
| 68 | Thickness of transformer tank |  |  |  |
|  | * Sides | mm |  |  |
|  | * Bottom | mm |  |  |
|  | * Top | mm |  |  |
| 69 | Material of transformer tank |  |  |  |
| 70 | Thickness of radiator plates | mm |  |  |
| 71 | Total volume of conservator | Litre |  |  |
| 72 | Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 15°C volume of transformer |  | 7.5% |  |
| 73 | Volumetric expansion of oil from 0° to 90°C | m3 |  |  |
| 74 | Pressure increase inside tank due to expansion of oil |  |  |  |
| 75 | Masses of transformer |  |  |  |
|  | * Core and coils | kg |  |  |
|  | * Total mass excluded oil | kg |  |  |
|  | * Oil mass |  |  |  |
|  | * in tank | kg |  |  |
|  | * in radiators | kg |  |  |
|  | * total | kg |  |  |
|  | * Total mass | kg |  |  |
| 76 | Mass of transformer as arranged for transport (heaviest part) | kg |  |  |
| 77 | Dimensions of transformer arranged for transport |  |  |  |
|  | * Height | m |  |  |
|  | * Width | m |  |  |
|  | * Length | m |  |  |
| 78 | Filling medium of transformer tank for shipment |  | Nytro gas |  |
| 79 | Maximum sound pressure level (NEMA TR1 – 5dB(A)) | dB(A) | 74 |  |
| 80 | Conservator vessel, radiators, fan grilles, control boxes or cubicles and pipework anticorrosion protection |  | Hot dip galvanized and painted |  |
| 81 | Tank anticorrosion protection |  |  |  |
| 82 | Supply voltage for transformer auxiliaries | V | 415/240 AC |  |
| 83 | Control/Protection voltage | V | 110 DC |  |
| 84 | Surge Arrester TV winding |  |  |  |
|  | * Type |  | MOA |  |
|  | * Type designation |  |  |  |
|  | * Standard |  | IEC 60099-4 |  |
|  | * Rated/system voltage | kV |  |  |
|  | * Maximum overvoltage factor on the system due to any switching duty | pu | 1.7 |  |
|  | * Rated system frequency | Hz | 50 |  |
|  | * Condition of system neutral |  | Solid |  |
|  | * Nominal Discharge current | kAc rest | 10 |  |
|  | * Energy capability as per IEC 60099-4 | kJ/kV | >4 |  |
|  | * Rated Voltage – MOA | kV | 12 |  |
|  | * Long duration discharge class as per IEC 99-1 | Class | SL |  |
|  | * Maximum Continuous Operating Voltage (COV) | kV | 9.6 |  |
|  | * TOV capability for |  |  |  |
|  | * 1sec | kV |  |  |
|  | * 10sec | kV |  |  |
|  | * Maximum residual voltage with current wave |  |  |  |
|  | * Switching Surges – 1kA/2kA | kV | To IEC 60099 |  |
|  | * 8/20 μs – 5kA | kV | To IEC 60099 |  |
|  | * 8/20 μs – 20kA | kV | To IEC 60099 |  |
|  | * Discharge current withstand strength |  |  |  |
|  | * High current 4/10 μs | KAp | To IEC 60099 |  |
|  | * Low current 2000 μs | KAp | To IEC 60099 |  |
| 85 | Manufacturer quality assurance |  | Yes |  |
|  | * According to ISO 9000, 9001, 9002, 9003 and 9004 | Validity |  |  |
|  | * Certificate attached to the offer | Yes/No | Yes |  |
| 86 | Type test certificate to be issued by: |  |  |  |
|  | * Independent laboratory or independently witnessed type test certificate | Yes/No | Yes |  |
|  | * Certificate attached to the offer will not be older than 4 years | Yes/No | Yes |  |
| 87 | Routine/Special/Type Tests to be performed: |  |  |  |
|  | * Chopped Wave Lightning Impulse Test   test as appropriate to transformer HV Um |  | Yes (Routine) |  |
|  | * Measurement of zero-sequence impedance |  | Yes(Special) |  |
|  | * Determination of sound levels |  | Yes (Type) |  |
|  | * Measurement of harmonics of no-load current |  | Yes (Special) |  |
|  | * Frequency response analysis (FRA) |  | Yes (Special) |  |
|  | * Measurement of the power by the fan motors and oil pumps |  | Yes(Type) |  |
|  | * Check of external coating |  | Yes(Special) |  |
|  | * Determination of capacitance, windings to earth and between windings |  | Yes(Routine) |  |
|  | * Measurement of insulation resistance to earth and loss angle of insulation system capacitances |  | Yes(Routine) |  |
|  | * Short circuit withstand test/calculations |  | Yes (Calculation) |  |
| 88 | Wheel locking capability on Transformer rails | Yes/No | Yes |  |
| 89 | Standards |  | IEC 60076, 60137, 60214 |  |

# 11/0.415kV; 500kVA EARTHING/AUXILIARY TRANSFORMERS

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer & Place of manufacturing |  |  |  |
| 2 | Type designation |  |  |  |
| 3 | Type |  | Three phase, oil immersed, core type |  |
| 4 | Mounting |  | Outdoor |  |
| 5 | Rated voltage ratio | kV | 11/0.415 |  |
| 6 | % Z (Impedance) | % | 4 |  |
| 7 | Rated frequency | Hz | 50 |  |
| 8 | Vector group |  | ZNyn11 |  |
| 9 | Cooling |  | ONAN |  |
| 10 | Method of earthing |  |  |  |
|  | * HV winding |  | Solid |  |
|  | * LV winding |  | Solid |  |
| 11 | Type (graded/non-graded) of windings |  |  |  |
|  | * HV winding |  | Non-graded |  |
|  | * LV auxiliary winding |  | Non-graded |  |
| 12 | Rated voltage of windings |  |  |  |
|  | * HV winding | kV | 11 |  |
|  | * LV auxiliary winding | kV | 0.415 |  |
| 13 | Highest voltage for equipment |  |  |  |
|  | * HV winding | kV | 12 |  |
|  | * LV auxiliary winding | kV | 1 |  |
| 14 | Rated lightning impulse withstand voltage at HV Terminal (at altitude <1000m) | kV | 95 |  |
| 15 | Rated power frequency withstand voltage (at altitude <1000m) |  |  |  |
|  | * HV terminal | kV | 28 |  |
|  | * LV terminal | kV | 3 |  |
|  | * HV neutral terminal | kV | 28 |  |
| 16 | Rated power at site conditions (secondary side) | kVA | 500 |  |
| 17 | Limitation and withstanding of fault current in neutral for 30s (rated short-time neutral current/rated short-time neutral current duration) | A/s | 1000/30 |  |
| 18 | Maximum temperature rise at rated power at: |  |  |  |
|  | * Windings | K | 55 |  |
|  | * Hot spot of windings | K | 68 |  |
|  | * Top oil | K | 50 |  |
|  | * Oil at inlet of cooler | K |  |  |
|  | * Oil at outlet of cooler | K |  |  |
|  | * Core | K |  |  |
| 19 | Temperature rise of winding due to short circuit duration of 2s and HV side short circuit current of 25 kA |  |  |  |
|  | * Copper windings | °C | 250 |  |
|  | * Aluminium windings | °C | 200 |  |
| 20 | No load losses at rated voltage and rated frequency | kW | 1.5 |  |
| 6.21 | Load losses at 75°C, and rated frequency, rated power and principal tapping: | kW | 8.5 |  |
| 22 | Maximum current density at rated power: |  |  |  |
|  | * HV winding | A/mm2 |  |  |
|  | * LV auxiliary winding | A/mm2 |  |  |
| 23 | Symmetrical short circuit withstand current (duration 2 s) at: |  |  |  |
|  | * HV terminal | kA | 25 |  |
|  | * LV auxiliary terminal | kA | Min 20 |  |
| 24 | Magnetising current (HV winding) |  |  |  |
|  | * At 90% rated voltage | A |  |  |
|  | * At 100% rated voltage | A |  |  |
|  | * At 110% rated voltage | A |  |  |
| 25 | Maximum flux density in core at rated voltage, power frequency and principal tapping | T |  |  |
| 26 | Type of tap changing |  | Off-load |  |
| 27 | Type designation of off-load tap changer |  |  |  |
| 28 | Tapped winding |  | HV |  |
| 29 | Tapping range |  | +5% -5% |  |
| 30 | Tapping step |  | 2.5% |  |
| 31 | Number of steps (positions) |  | 4 (5) |  |
| 32 | Impedance voltage range at 75°C and principal tapping: |  |  |  |
|  | * At principal tapping |  | > 4% |  |
|  | * At maximum voltage ratio |  | >4% |  |
|  | * At minimum voltage ratio |  | >4% |  |
| 33 | Resistance of winding at 75°C and principal tapping: |  |  |  |
|  | * HV side | Ω/phase |  |  |
|  | * LV auxiliary side | Ω/phase |  |  |
| 34 | Zero phase sequence impedance of inter-star windings at 75°C (LV windings open-circuit) | Ω/phase |  |  |
| 35 | Zero phase sequence impedance of LV windings at 75°C (inter-star windings open-circuit) | Ω/phase |  |  |
| 36 | Terminal connection |  |  |  |
|  | * HV + HVN terminal   Note\*: Separable connector, e.g. Euro mold or similar |  | Air-filled cable box\* |  |
|  | * LV + LVN terminal |  | Air-filled cable box |  |
| 37 | Isolating link for test purposes (not required if separable connector allows testing) |  |  |  |
|  | * HV terminal |  | No |  |
|  | * LV terminal |  | No |  |
| 38 | Mounting of current transformer at |  |  |  |
|  | * HV terminal |  | In tank |  |
|  | * Neutral terminals |  | In tank |  |
| 39 | Current transformers  Note: CT data need to be confirmed by contractor’s calculation |  |  |  |
|  | HV Neutral |  |  |  |
|  | * Number of cores |  | Two |  |
|  | * Rated extended primary current |  | 120% |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | * I core | A | 500/1  (to confirm by calculation) |  |
|  | * II core | A | 500/1  (to confirm by calculation) |  |
|  | * Class |  |  |  |
|  | * I core |  | 5P20 |  |
|  | * II core |  | PX |  |
|  | * Knee point voltage (Ek) |  |  |  |
|  | * I core | V |  |  |
|  | * II core | V | >750 |  |
|  | * Exciting current (IE ) at Ek |  |  |  |
|  | * I core |  |  |  |
|  | * II core |  |  |  |
|  | * Rated output (Burden to be 25-100% rated burden) |  |  |  |
|  | * I core | VA | 20 |  |
|  | * II core | VA |  |  |
|  | LV Neutral |  |  |  |
|  | * Number of cores |  | 1 |  |
|  | * Rated extended primary current |  | 120% |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | * I core |  | 5000/1  (to confirm by calculation) |  |
|  | * Class |  |  |  |
|  | * I core |  | X |  |
|  | * Knee point voltage (Ek) |  |  |  |
|  | * I core | V | >750 |  |
|  | * Exciting current (IE ) at Ek |  |  |  |
|  | * I core |  |  |  |
|  | * Rated output (Burden to be 25-100% rated burden) |  |  |  |
|  | * I core | VA |  |  |
|  | All class PX CTs shall have a rated secondary current, ISN |  |  |  |
| 40 | Oil: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Standards |  | IEC 60296 |  |
|  | * Minimum flash point | °C |  |  |
|  | * Viscosity |  |  |  |
|  | * At 40°C | mm2/s |  |  |
|  | * At -30 °C | mm2/s |  |  |
|  | * At 80°C | mm2/s |  |  |
|  | * Maximum dielectric strength for 1 min | kV |  |  |
|  | * Dielectric factor |  |  |  |
|  | * Acidity (neutralization value) | mgKOH/g |  |  |
| 41 | Type of dehydrating breather (Non-sealed transformers) |  | Auto Dehydrating Breather |  |
| 42 | Conductor material (e.g. copper, work hardened copper, etc.): |  |  |  |
|  | 1. HV windings |  |  |  |
|  | 1. LV windings |  |  |  |
| 43 | Conductor insulation: |  |  |  |
|  | 1. HV winding |  |  |  |
|  | 1. LV winding |  |  |  |
| 44 | Calculated thermal time constant | min |  |  |
| 45 | Thickness of transformer tank |  |  |  |
|  | * Sides | mm |  |  |
|  | * Bottom | mm |  |  |
|  | * Top | mm |  |  |
| 46 | Material of transformer tank |  |  |  |
| 47 | Thickness of radiator plates | mm |  |  |
| 48 | Total volume of conservator | litres |  |  |
| 49 | Masses of transformer |  |  |  |
|  | * Core and coils | kg |  |  |
|  | * Total mass excluded oil | kg |  |  |
|  | * Oil mass |  |  |  |
|  | * in tank | kg |  |  |
|  | * in radiators | kg |  |  |
|  | * total | kg |  |  |
|  | * Total mass | kg |  |  |
| 50 | Mass of transformer as arranged for transport (heaviest part) | kg |  |  |
| 51 | Dimensions of transformer arranged for transport |  |  |  |
|  | * Height | m |  |  |
|  | * Width | m |  |  |
|  | * Length | m |  |  |
| 52 | Maximum noise level (to NEMA TR1) | dB | 56 |  |
| 53 | Conservator vessel, radiators, fan grilles, control boxes or cubicles and pipework anticorrosion protection |  | Hot dip galvanized and painted |  |
| 54 | Tank anticorrosion protection |  |  |  |
| 55 | Control/Protection voltage | V | 110 DC |  |
| 56 | Manufacturer quality assurance |  |  |  |
| 56.1 | * According to ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 56.2 | Standards |  | IEC 60076, NEMA TR1 (Noise) |  |
| 57 | Type test certificates to be issued by: |  |  |  |
|  | * Independent Laboratory or independently witnessed type test certificate; certificate to be attached to the offer | Yes/No | Yes |  |
| 58 | Routine tests |  | According to IEC 60076 |  |
| 59 | Routine/Special/Type Tests to be performed: |  |  |  |
|  | * Demonstration of ability to withstand rated short-time neutral current | Yes/No | No |  |
|  | * Measurement of no-load loss and current at maximum operating voltage | Yes/No | No |  |
|  | * Determination of acoustic sound levels | Yes/No | No(Type) |  |
|  | * Measurement of zero-sequence impedance | Yes/No | Yes(Routine) |  |
|  | * Measurement of the harmonics of the no-load current | Yes/No | No |  |
|  | * Short-circuit test of the transformer with the secondary winding short-circuited. | Yes/No | No |  |

# 400kV 50MVAR ShuNt reactor

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | **General** |  |  |  |
| 1.1 | Manufacturer & Place of manufacturing |  |  |  |
| 1.2 | Type designation |  |  |  |
| 1.3 | Type |  | Outdoor, Oil Immersed, linear |  |
| 1.4 | Construction (Gapped core/Air-cored shielded) |  | Gapped core |  |
| 1.5 | Principal standards |  | IEC 60076-1,- 2,-3, -6 |  |
| 1.6 | Maximum | °C | 45 |  |
| 1.7 | Average of hottest month | °C | 40 |  |
| 1.8 | Annual average | °C | 35 |  |
| 1.9 | Altitude (if >1000m) | m | 2000 |  |
| 1.10 | Rated voltage | kV | 400 |  |
| 1.11 | Highest voltage for equipment, Um; Reactor must be able to operate continuously at this voltage. | kV | 420 |  |
| 1.12 | Rated frequency | Hz | 50 |  |
| 1.13 | Vector group |  | YN |  |
| 1.14 | Cooling |  | ONAN |  |
| 1.15 | Method of earthing |  | Solid |  |
| 1.16 | Type (graded/non-graded) of windings |  | Graded |  |
| 1.17 | Rated lightning impulse withstand voltage at: |  |  |  |
|  | * HV terminals | kV | 1425 |  |
|  | * HV neutral-end terminal | kV | 550 |  |
|  | Rated switching impulse voltage | kV | 1175 |  |
| 1.18 | Rated power frequency withstand voltage at |  |  |  |
|  | * HV Terminal(design value) | kV | 630 |  |
|  | * HV enhancement level | kV | 416 |  |
|  | * HV PD level (250 pC max during 1 hour) | kV | 365 |  |
| 2 | Rated power: |  |  |  |
|  | * Rated current IN | A | 72 |  |
|  | * Rated (reactive) power at Ur | MVAr | 50 |  |
|  | * Rated reactance XN | Ω/phase | 3200 |  |
|  | * Zero sequence reactance X0 | Ω | 3200 |  |
| 3 | Magnetic characteristic: Linear to percent of rated voltage | % | 110% |  |
| 4 | Maximum temperature rise at rated power at: |  |  |  |
|  | * Windings | K | 50 |  |
|  | * Hot spot of windings | K | 68 |  |
|  | * Top oil | K | 55 |  |
|  | * Oil at inlet of cooler | K |  |  |
|  | * Oil at outlet of cooler | K |  |  |
|  | * Core | K |  |  |
|  | * Tank Wall | K |  |  |
| 5 | Losses at rated voltage and rated frequency | kW | 120 |  |
| 6 | Maximum current density at rated power: |  |  |  |
|  | * HV winding | A/mm² | ≤3.5 |  |
| 7 | Maximum flux density at rated voltage, power frequency: |  |  |  |
|  | * Wound limbs/core packets | T | 1.35 |  |
|  | * Yokes | T |  |  |
|  | * Shield | T |  |  |
| 8 | Resistance of winding at 75 °C and principal tapping: | Ω/phase |  |  |
| 9 | Terminal connection |  |  |  |
|  | * Bushing standards |  | IEC 60137 |  |
|  | * Pollution Class (> IEC Class IV)) | (mm/kV) | IV(31) |  |
|  | * Is KD Correction factor |  | Yes |  |
| 9.1 | HV terminals |  |  |  |
|  | * Minimum Voltage Class | kV | 420 |  |
|  | * Minimum Current rating | A | 1600 |  |
|  | * Manufacturer |  |  |  |
|  | * Manufacturers designation |  |  |  |
|  | * Type (OIP/RIP) |  | OIP |  |
|  | * Insulator (Silicon rubber/porcelain) |  | Porcelain |  |
| 9.2 | HV neutral-end terminals |  |  |  |
|  | * Connection |  | AIS |  |
|  | * Creepage Distance (IEC Class IV) | mm | 31 |  |
|  | * Minimum Voltage Class | kV | 145 |  |
|  | * Minimum Current rating | A | 1250 |  |
|  | * Manufacturer |  |  |  |
|  | * Manufacturers designation |  |  |  |
|  | * Type (Cast resin/RIP/Porcelain) |  | Porcelain |  |
| 10 | Current transformers |  |  |  |
| 10.1 | HV-Bushing turrets |  |  |  |
|  | * Number of cores |  | 3 |  |
|  | * Rated extended primary current |  |  |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | Core-I | A | 1000-500/1 |  |
|  | Core-II | A | 1000-500/1 |  |
|  | Core-III | A | 1000-500/1 |  |
|  | Class |  |  |  |
|  | Core-I |  | 5P20, 20VA |  |
|  | Core-II |  | 5P20, 20VA |  |
|  | Core-III |  | 5P20,20VA |  |
| 10.2 | HV Neutral |  |  |  |
|  | Number of cores/phase | 1 |  |  |
|  | Rated extended primary current |  |  |  |
|  | Ratio (TR = turns ratio) |  |  |  |
|  | Core-I | A | 1000-500/1 |  |
|  | Class |  |  |  |
|  | Core-I |  | 5P20,20VA |  |
|  |  |  |  |  |
| 10.3 | HV Neutral-end |  |  |  |
|  | * Number of cores | 1 |  |  |
|  | * Rated extended primary current |  |  |  |
|  | * Ratio (TR = turns ratio) |  |  |  |
|  | * Core-I | A | 1000-500/1 |  |
|  | * Class |  |  |  |
|  | * Core-I |  | 5P20,20VA |  |
| 11 | Radiators |  |  |  |
|  | * Tank or Separate Mounting |  |  |  |
|  | * Number of banks |  | One |  |
|  | * Number of radiators elements per bank |  |  |  |
| 12 | Oil |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Standards |  | IEC 60296 |  |
|  | * Minimum flash point | °C |  |  |
|  | * Viscosity |  |  |  |
|  | at 40 °C | mm²/s | IEC |  |
|  | at -30 °C | mm²/s | IEC |  |
|  | at 80 °C | mm²/s | IEC |  |
|  | * Maximum dielectric strength for 1 min. | kV | IEC |  |
|  | * Dielectric factor |  |  |  |
|  | * Acidity (neutralization value) | mgKOH/g | IEC |  |
|  | Oil preservation system |  |  |  |
|  | * Type |  | Air Cell/bag |  |
|  | * Breather |  | Auto Dehydrating Breather |  |
|  | * Oil Level Gauge |  | Magnetic |  |
| 13 | Types and arrangement of winding: |  |  |  |
|  | * Conductor Material (e.g., copper, work hardened copper, etc.) |  |  |  |
|  | * Conductor type (CTC, other) |  |  |  |
| 14 | Conductor insulation: |  |  |  |
|  | * Calculated thermal time constant | Hours |  |  |
| 15 | Oil circulation (i.e., natural/partially  directed/directed) |  |  |  |
|  | * To the windings: |  | Natural |  |
|  | * Through the windings: |  | Directed |  |
| 16 | Core construction: |  |  |  |
|  | * Core segment |  | Packets |  |
|  | * Core gaps |  | Ceramic |  |
|  | * Taped/banded/bolted limbs |  | Banded |  |
|  | * Taped/banded/bolted yokes |  | Bolted |  |
|  | * Taped/banded/bolted shield |  | Banded |  |
|  | * Number of limbs |  | 5 |  |
|  | * Type of joint in core (90% butt, overlap, mitre, etc.) |  |  |  |
|  | * Core steel |  |  |  |
|  | * Specific loss of core steel at 1.5 Tesla | W/kg | 0.82 |  |
| 17 | Flux density, at Ur 400 kV |  |  |  |
|  | * Wound limbs (packets) | T |  |  |
|  | * Yokes | T |  |  |
|  | * Shield | T |  |  |
| 18 | Max at 440 kV (110% rated voltage) |  |  |  |
|  | * Wound limbs (packets) | T |  |  |
|  | * Yokes | T |  |  |
|  | * Shield | T |  |  |
| 19 | Thickness of reactor tank |  |  |  |
|  | * Sides | mm | 9 |  |
|  | * Bottom | mm | 12 |  |
|  | * Top | mm | 20 |  |
|  | * Material of reactor tank |  |  |  |
| 20 | Thickness of radiator plates | mm |  |  |
| 21 | Total volume of conservator | liters |  |  |
| 22 | Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 15 °C volume of transformer | % | 7.5% |  |
| 23 | Volumetric expansion of oil from 0° to 90 °C | m³ |  |  |
| 24 | Pressure increase inside tank due to  expansion of oil |  | 0.75 PSI |  |
| 25 | Masses of reactor |  |  |  |
|  | * Core and coils | Kg |  |  |
|  | * Total mass excluded oil | Kg |  |  |
|  | * Oil mass |  |  |  |
|  | * in tank | Kg |  |  |
|  | * in radiators | Kg |  |  |
|  | * total | kg |  |  |
|  | * Total mass | Kg |  |  |
| 26 | Mass of reactor as arranged for transport (heaviest Dimensions of reactor arranged for transport) | kg |  |  |
| 27 | Dimension of reactor arranged for transport |  |  |  |
|  | * Height | m |  |  |
|  | * Width | m |  |  |
|  | * Length | m |  |  |
| 28 | Filling medium of reactor tank for shipment |  | Dry Air |  |
| 29 | Maximum noise level | dB(A) | 75 |  |
| 30 | Conservator vessel, radiators, control boxes or cubicles and pipework anticorrosion protection |  | Hot dip  galvanized  and painted |  |
| 31 | Tank anticorrosion protection |  | Yes |  |
| 32 | Supply voltage for reactor auxiliaries | V | 415/240 AC |  |
| 33 | Control/Protection voltage | V | 110 DC |  |
| 34 | Manufacturer quality assurance |  |  |  |
|  | According to ISO 9000, 9001, 9002,  9003 and 9004; List current accreditation |  | Yes |  |
| 35 | Type test certificate to be issued by: |  |  |  |
|  | Independent laboratory or independently witnessed type test certificate |  | yes |  |
| 36 | Routine tests |  | To IEC  60076-6 |  |
| 37 | Type tests |  | To IEC  60076-6 |  |
|  | *Note: The method of carrying out loss*  *measurements and any limitations of*  *manufacturer’s test field which restricts the test programme are to be advised with bid documents.* |  |  |  |
| 38 | Special Tests to be performed:  (R=Routine/All units: T=Type/1 unit)) |  |  |  |
|  | * Measurement of zero-sequence reactance |  | Yes(T) |  |
|  | * Determination of linearity |  | Yes(T) |  |
|  | * Measurement of mutual reactance |  | Yes(T) |  |
|  | * Determination of sound levels |  | Yes(T) |  |
|  | * Measurement of harmonics |  | Yes(T) |  |
|  | * Verification of magnetic characteristic |  | Yes (T) |  |

# TRANSFORMER ONLINE CONDITION MONITORING SYSTEM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | **General** |  |  |  |
| 2 | Manufacturer |  |  |  |
| 3 | Type |  |  |  |
| 4 | **Field module** |  |  |  |
| 5 | Sampling rate | ms |  |  |
| 6 | Data resolution | ms | 1 |  |
| 7 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 8 | Protection degree of panel/box | IP | 55 |  |
| 9 | Range of operating temperature | °C |  |  |
| 10 | Communication |  |  |  |
| 11 | Local interface for PC/Laptop connection |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS232/Ethernet etc.) |  |  |  |
| 12 | Remote Control and Monitoring |  |  |  |
|  | Communication ports (Front/rear etc.) |  | Rear |  |
|  | Physical links (RS485/Fibre optic etc.) |  | Fibre optic |  |
|  | Protocol |  | IEC 61850 |  |
| 13 | Centralized HMI PC for analysis, evaluation and diagnostic |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic etc.) |  | Fibre Optic |  |
|  | Protocol |  |  |  |
| 14 | **Centralized HMI PC for analysis, evaluation and diagnostic** |  |  |  |
|  | Manufacturer |  |  |  |
|  | Model |  |  |  |
|  | Processor |  |  |  |
|  | Type |  |  |  |
|  | Word length | Bits |  |  |
|  | Clock speed (minimun) | GHz | 3 |  |
|  | Memory size | GB | 6 |  |
|  | Supplied (minimum) | Mb |  |  |
|  | Supportable/expandable | Gb |  |  |
|  | Hard disk size | GB |  |  |
|  | Supplied (minimum)  Supportable/expandable | GB  GB |  |  |
|  | Optical Storage | Yes/No | YES |  |
|  | Pointer Device |  |  |  |
|  | Operating system |  |  |  |
|  | Operator interface screen | inch | 24 |  |
|  | Operating temperature range | °C |  |  |
|  | Maximum relative humidity | % |  |  |
|  | Nominal voltage | Vac |  |  |
|  | Operating frequency | Hz |  |  |
|  | Power requirement | W |  |  |
| 15 | **Minimum quantities to be measured** |  |  |  |
|  | Oil temperature | Yes/No | Yes |  |
|  | Hot-spot-temperature | Yes/No | Yes |  |
|  | Moisture-in-oil content | Yes/No | Yes |  |
|  | Gas-in-oil content and gas consistency | Yes/No | Yes |  |
|  | Gas quantity and rate in Buchholz relay | Yes/No | Yes |  |
|  | Oil pressure | Yes/No | Yes |  |
|  | Oil level | Yes/No | Yes |  |
|  | Winding temperature | Yes/No | Yes |  |
|  | Humidity of air in conservator | Yes/No | Yes |  |
|  | Actual losses | Yes/No | Yes |  |
|  | Overload capacity | Yes/No | Yes |  |
|  | Emergency overloading time | Yes/No | Yes |  |
|  | Partial discharge | Yes/No | YES: Combination of UHF and electrical method |  |
|  | Ambient air temperature | Yes/No | Yes |  |
|  | Ambient air humidity | Yes/No | Yes |  |
|  | Ambient air pressure | Yes/No | Yes |  |
|  | Load currents of bushings | Yes/No | Yes |  |
|  | Over currents of bushings | Yes/No | Yes |  |
|  | Operating voltages of bushings | Yes/No | Yes |  |
|  | Over voltages of bushings | Yes/No | Yes |  |
|  | Bushing capacitance and capacitive displacement currents | Yes/No | Yes |  |
|  | Tap changer position and number of switching operations | Yes/No | Yes |  |
|  | Sum of switched load current tap changer | Yes/No | Yes |  |
|  | Power consumption of motor-drive | Yes/No | Yes |  |
|  | Contact wear | Yes/No | Yes |  |
|  | Operating conditions and operating time of fans | Yes/No | Yes |  |
|  | Cooling efficiency and power | Yes/No | Yes |  |
|  | Intake and outlet cooling equipment temperatures | Yes/No | Yes |  |
| 16 | **Type Tests** |  |  |  |
| 16.1 | Atmospheric Environment |  |  |  |
|  | Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 16.2 | Relative Humidity |  |  |  |
|  | Operation at 93% | Yes/No | Yes |  |
|  | Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 16.3 | Enclosure |  |  |  |
|  | IEC 60529 |  | IP50 |  |
| 16.4 | Mechanical Environment |  |  |  |
|  | Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 16.5 | Insulation |  |  |  |
|  | Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | Dielectric Tests  IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage  IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 16.6 | Electromagnetic compatibility |  |  |  |
|  | 1MHz Burst disturbance test,  IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | Electrostatic Discharge  IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | Radiated Electromagnetic Field Disturbance  IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | Electromagnetic Emissions  IEC 60255-25 | Yes/No | Yes |  |
|  | Fast Transient Disturbance  IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 16.7 | Type test certificate provided | Yes/No | Yes |  |

# 11kV XLPE INSULATED CABLE SYSTEM (soild bonding)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Name of manufacturer |  |  |  |
| 2 | Location of manufacturing site |  |  |  |
| 3 | Manufacturers Quality Certification |  | ISO 9001 |  |
| 4 | * Certified by (Company Name) |  |  |  |
| 5 | * Certification valid till (year) |  |  |  |
| 6 | Circuit rating required | kVA | 630 |  |
| 7 | General description of cable |  |  |  |
|  | * number of cores |  | 1 |  |
|  | * system voltage | kV | 11 |  |
|  | * conductor size | mm2 | To be enclosed with bid |  |
|  | * Insulation Type |  | XLPE |  |
|  | * metal sheath type |  | Lead |  |
|  | * oversheath type |  | MDPE |  |
| 8 | Year of first commercial operation of cable type |  |  |  |
| 9 | **INSULATION CO-ORDINATION** |  |  |  |
| 9.1 | Highest system voltage (Um) (insulation class) | kV | 12 |  |
| 9.2 | Nominal voltage between conductors (U) | kV | 11 |  |
| 9.3 | Rated frequency | Hz | 50 |  |
| 9.4 | Nominal voltage between conductor and sheath (Uo) | kV | 6.35 |  |
| 9.5 | Rated impulse withstand voltage (Up) (at altitude <1000m) | kV | 95 |  |
| 9.6 | Rated short duration power frequency withstand voltage (at altitude <1000m) | kV | 28 |  |
| **10** | **RATINGS** |  |  |  |
| 10.1 | Maximum continuous direct-buried current rating, assuming, | Amp | 687 |  |
| 10.2 | * Soil thermal resistivity of 2.0K.m/W |  |  |  |
| 10.3 | * Flat spaced configuration, phase spacing of 250mm |  |  |  |
| 10.4 | * Special bonding of metal sheaths |  |  |  |
| 10.5 | * Guaranteed Current Rating (Single Circuit in Trench) | A |  |  |
| 10.6 | * Guaranteed Current Rating (Double Circuit in one Trench, distance between middle phases, s = 1500 mm) | A |  |  |
| 10.7 | * Ground temperature at burial depth | °C |  |  |
| 10.8 | * Calculation Method |  |  |  |
| 10.9 | Maximum continuous in-air current rating, assuming, |  |  |  |
| 10.10 | * Air temperature (in shade) of 35 °C |  |  |  |
| 8.10.11 | * Special bonding of metal sheaths |  |  |  |
| 10.12 | * Flat spaced configuration, group/phase spacing of 150mm |  |  |  |
| 10.13 | * Thermally independent of other cable circuits |  |  |  |
| 10.14 | * Guaranteed Current Rating (single circuit) | A |  |  |
| 10.15 | * Calculation Method |  |  |  |
| 10.16 | Maximum permissible core temperature for continuous operation | °C | 90 |  |
| 10.17 | Short circuit capacity for 1 sec |  |  |  |
| 10.18 | * Short circuit current | kA | As per IEC60502 |  |
| 10.19 | * Permissible maximum sheath temperature | °C | 200 |  |
| 10.20 | * Permissible maximum conductor temperature | °C | 250 |  |
| 10.21 | Permissible emergency overload |  |  |  |
| 10.22 | Applied on 100% continuous load |  |  |  |
| 10.23 | * Emergency current rating | A |  |  |
| 10.24 | * Maximum emergency temperature | °C |  |  |
| 10.25 | * Allowable duration/operation | hours |  |  |
| 10.26 | * Allowable total duration/annum | hours |  |  |
| 10.27 | * Maximum average duration/annum on total life of cable | hours |  |  |
| 10.28 | Applied on 50% continuous load |  |  |  |
| 10.29 | * Emergency current rating | A |  |  |
| 10.30 | * Maximum emergency temperature | °C |  |  |
| 10.31 | * Allowable duration/operation | hours |  |  |
| 10.32 | * Allowable total duration/annum | hours |  |  |
| 10.33 | * Maximum average duration/annum on total life of cable | hours |  |  |
| 10.34 | Applied on 20% continuous load |  |  |  |
| 10.35 | * Emergence current rating | A |  |  |
| 10.36 | * Maximum emergency temperature | °C |  |  |
| 10.37 | * Allowable duration/operation | hours |  |  |
| 10.38 | * Allowable total duration/annum | hours |  |  |
| 10.39 | * Maximum average duration/annum on total life of cable | hours |  |  |
| 11 | **CONSTRUCTION FEATURES** |  |  |  |
| 11.1 | Conductor |  |  |  |
| 11.2 | * Material |  | Cu |  |
| 11.3 | * Nominal cross-section | mm2 |  |  |
| 11.4 | * Shape of conductor |  |  |  |
| 11.5 | * Overall diameter | mm |  |  |
| 11.6 | * Water blocking method |  | Tape/yarn |  |
| 11.7 | * Semiconducting binder tape |  | Yes |  |
| 11.8 | Conductor screen |  |  |  |
| 11.9 | * Type of material |  | Fully bonded semicon. XLPE |  |
| 11.10 | * Nominal thickness | mm |  |  |
| 11.11 | * Minimum thickness | mm |  |  |
| 11.12 | * Nominal overall diameter | mm |  |  |
| 11.13 | * Compound Identification Reference |  | Yes |  |
| 11.14 | Insulation |  |  |  |
| 11.15 | * Material |  | XLPE |  |
| 11.16 | * Nominal thickness | mm |  |  |
| 11.17 | * Minimum thickness | mm |  |  |
| 11.18 | * Nominal overall diameter | mm |  |  |
| 11.19 | * Maximum continuous operating temperature | °C | 90 |  |
| 11.20 | * Compound Identification Reference | Yes/No | Yes |  |
| 11.21 | * Maximum stress at nominal voltage |  |  |  |
| 11.22 | * At conductor screen | kV/mm |  |  |
| 11.23 | * At insulation screen | kV/mm |  |  |
| 11.24 | * Maximum stress at impulse voltage |  |  |  |
| 11.25 | * At conductor screen | kV/mm |  |  |
| 11.26 | * At insulation screen | kV/mm |  |  |
| 11.27 | Insulation screen |  |  |  |
| 11.28 | * Type of material |  | Fully bonded semicon. XLPE |  |
| 11.29 | * Nominal thickness | mm |  |  |
| 11.30 | * Nominal overall diameter | mm |  |  |
| 11.31 | * Compound Identification Reference | Yes/No | Yes |  |
| 11.32 | * Indelible ink marking on screen | Yes/No | Yes |  |
| 11.33 | XLPE Manufacturing Methods |  |  |  |
| 11.34 | * Extrusion line type e.g. CCV, MDCV, VCV |  |  |  |
| 11.35 | * Single pass, triple extrusion | Yes/No | Yes |  |
| 11.36 | * Curing method |  | Dry |  |
| 11.37 | * Cooling method |  | Dry |  |
| 11.38 | * Degassing Period | days |  |  |
| 11.39 | Bedding for moisture absorption |  |  |  |
| 11.40 | * Type and material |  |  |  |
| 11.41 | * Nominal thickness | mm |  |  |
| 11.42 | * Minimum thickness | mm |  |  |
| 11.43 | * Nominal overall diameter over bedding | mm |  |  |
| 11.44 | Metallic screen |  |  |  |
| 11.45 | * Type and material |  | Copper wire |  |
| 11.46 | * Nominal thickness | mm |  |  |
| 11.47 | * Minimum thickness | mm |  |  |
| 11.48 | * Wire diameter | No. |  |  |
| 11.49 | * Nominal diameter over the screen | mm |  |  |
| 11.50 | * Cross sectional area of screen | mm2 |  |  |
| 11.51 | * Short time current density (1 sec) | kA/mm2 |  |  |
| 11.52 | Bedding/Binder tape |  |  |  |
| 11.53 | * Type and material |  |  |  |
| 11.54 | * Nominal thickness | mm |  |  |
| 8.11.55 | * Minimum thickness | mm |  |  |
| 11.56 | * Nominal overall diameter over bedding | mm |  |  |
| 11.57 | Metallic sheath |  |  |  |
| 11.58 | * Type and material |  | Lead-alloy 1/2C |  |
| 11.59 | * Nominal thickness | mm |  |  |
| 11.60 | * Minimum thickness | mm |  |  |
| 11.61 | * Nominal diameter over the sheath | mm |  |  |
| 11.62 | * Cross sectional area of sheath | mm2 |  |  |
| 11.63 | * Short time current density (1 sec.) | kA/mm2 |  |  |
| 11.64 | Protective anti-corrosion external sheath covering |  |  |  |
| 11.65 | * Bitumen undercoat layer |  |  |  |
| 11.66 | * Type and material |  | MDPE |  |
| 11.67 | * Color |  | Black |  |
| 11.68 | * Nominal thickness | mm |  |  |
| 11.69 | * Minimum thickness | mm |  |  |
| 11.70 | * Termite resistant | Yes/No | Yes |  |
| 11.71 | * Type of anti-termite protection |  |  |  |
| 11.72 | * Thermal resistivity | K.m/W | Max 6.0 |  |
| 11.73 | Type of conductive outer layer |  | Graphite/or semicon. polymer |  |
| 11.74 | Nominal overall cable diameter | mm |  |  |
| 11.75 | Weight of completed cable |  |  |  |
| 11.76 | * Copper | kg/m |  |  |
| 11.77 | * Insulation | kg/m |  |  |
| 11.78 | * Lead-Alloy | kg/m |  |  |
| 11.79 | * Gross Weight | kg/m |  |  |
| **12** | **LOSSES** |  |  |  |
| 12.1 | Maximum dielectric loss per metre / phase when operating at nominal voltage and frequency and at maximum conductor temperature | W/m |  |  |
| 12.2 | Maximum sheath loss per metre / phase when operating at nominal voltage and frequency and at full load condition with sheath bonded and earthed as recommended (sectionalizing cross bonding) | W/m |  |  |
| 12.3 | Maximum conductor loss per metre / phase when operating at nominal voltage and frequency and at full load condition. | W/m |  |  |
| 12.4 | Total loss of cable per metre / phase of three phase circuit | W/m |  |  |
| **13** | **ELECTRICAL VALUES** |  |  |  |
| 13.1 | Maximum d.c. resistance of conductor at 20oC | μΩ/m |  |  |
| 13.2 | Maximum a.c. resistance of conductor at operating temperature | μΩ/m |  |  |
| 13.3 | Equivalent reactance of three phase circuit at 50 Hz | μΩ/m |  |  |
| 13.4 | Electrostatic capacitance per conductor of cable at nominal voltage and operating temperature | pF/m |  |  |
| 13.5 | Maximum charging current per conductor at nominal voltage | mA/m |  |  |
| 13.6 | Charging capacity of three phase system (at Uo) | VAr/m |  |  |
| 13.7 | Maximum dielectric loss factor of cable at normal voltage and frequency at a conductor temperature of: |  |  |  |
| 13.8 | * 20°C |  |  |  |
| 13.9 | * 90°C |  |  |  |
| 13.10 | Positive & Negative sequence impedance | Ω/m |  |  |
| 13.11 | Zero sequence impedance (as installed conditions) |  |  |  |
| 13.12 | * Resistance | Ω/m |  |  |
| 13.13 | * Reactance | Ω/m |  |  |
| 13.14 | * Capacitance | pF/m |  |  |
| 13.15 | Surge impedance | Ω |  |  |
| **14** | **BONDING & EARTHING** |  |  |  |
| 14.1 | Number of connections to earth |  |  |  |
| 14.2 | Interconnected sheaths at joint positions | Yes/No | Yes |  |
| **15** | **TYPE TEST CERTIFICATE** |  |  |  |
| 15.1 | Type test certificate (to be issued by independent laboratory or independently witnessed type test certificate available), to be attached to the offer and will not be older than 5 year | Yes/No | Yes |  |
| **16** | **OTHER INSTALLATION DATA** |  |  |  |
| 16.1 | Minimum cable bending radius when laid: |  |  |  |
|  | * Direct burial | mm |  |  |
|  | * In air | mm |  |  |
|  | * In ducts | mm |  |  |
|  | * At terminations (with former) | mm |  |  |
| 16.2 | Maximal permissible pulling force of total cable | kN |  |  |
| 16.3 | Maximal side wall bearing pressure to the cable at bending points | kN/m |  |  |
| 16.4 | Delivery length per drum |  |  |  |
|  | * Normal | m |  |  |
|  | * Maximum | m |  |  |
| 16.5 | Maximal weight of full steel drum with maximum delivery length of cable | kg |  |  |
| 16.6 | Steel Drum dimensions: |  |  |  |
|  | * Flange diameter | m |  |  |
|  | * Core diameter | m |  |  |
|  | * Width | m |  |  |
|  |  |  |  |  |

# LOW VOLTAGE CABLE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| **1** | **Low Voltage Power Cable** |  |  |  |
| 1.1 | Manufacturer |  |  |  |
|  | Name |  |  |  |
|  | Country |  |  |  |
|  | Type designation |  | Armoured multi conductor |  |
| 1.2 | Rated voltage | V | 1100 |  |
| 1.3 | Number of cores / size |  |  |  |
| 1.4 | Conductor material (Cu/Al) and its class acc. to IEC |  | High conductivity/plain annealed/copper |  |
| 1.5 | Type of conductor |  | Stranded |  |
| 9.1.6 | Min thickness & material of insulation | mm | 8 as per IEC 60502 |  |
| 1.7 | Type and thickness of inner sheath material | mm | LSOH |  |
| 1.8 | Whether shield is provided? (Yes/No) |  |  |  |
| 1.9 | Type and material of armor (wire/tape & Steel/Al) |  | Galvanized steel wire |  |
| 1.10 | Type and thickness of outer sheath material | mm | LSOH |  |
| 1.11 | High voltage test | kV |  |  |
| 1.12 | Short circuit withstand current/time of conductor. | kA/Sec | 57.20 |  |
| 1.13 | Minimum bending radius at minimum temperature |  |  |  |
| 1.14 | Conductor DC resistance at 20°c | Ω/km | 0.047 |  |
| 1.15 | Minimum temperature during installation | °C |  |  |
| 1.16 | Minimum pulling tension | N |  |  |
| 1.17 | Approx. weight of cable | kg/m |  |  |
| 1.18 | Core identification required | Yes/No | yes |  |
| 1.19 | Type and routine tests required | Yes/No | yes |  |
| 1.20 | Distance between cables laid horizontally or in flat |  | equal to the outer diameter of cables |  |
| **2** | **Control Cable** |  |  |  |
| 2.1 | Manufacturer |  |  |  |
|  | Name |  |  |  |
|  | Country |  |  |  |
| 2.2 | Type designation |  | Armoured Multi-conductor |  |
| 2.3 | Rated voltage | kV | 1000 |  |
| 2.4 | Type and material of conductor |  | Stranded/ high conductivity plain annealed copper |  |
| 2.5 | Diameter of each strand | mm |  |  |
| 2.6 | Number and cross section of wires in each cable |  |  |  |
|  | For CT cable (minimum) |  | 4 mm2 |  |
|  | For CVT cable (minimum) |  | 2.5 mm2 |  |
|  | For control cable |  | 2.5 mm2 |  |
| 2.7 | Insulation material |  | P.V.C or X.L.P.E |  |
| 2.8 | Material and thickness of inner sheath | mm | LSOH |  |
| 2.9 | Material and thickness of shield | mm | Lead or copper |  |
| 2.10 | Material and thickness of bedding for armor | mm |  |  |
| 2.11 | Material and thickness of armor | mm | Aluminium or galvanized steel |  |
| 2.12 | Material and thickness of outer sheath | mm | LSOH |  |
| 2.13 | Type of sheath between shield and armor |  |  |  |
| 2.14 | Short circuit withstand current/time of conductors | kA/Sec | 57.20 |  |
| 2.15 | Minimum bending radius at minimum temperature |  |  |  |
| 2.16 | Conductor DC resistance at 20°c | Ω/km | 0.047 |  |
| 2.17 | Minimum temperature during installation | °C |  |  |
| 2.18 | Minimum pulling tension | N |  |  |
| 2.19 | Core identification required | Yes/No | yes |  |
| 2.20 | Type and routine tests required | Yes/No | yes |  |
| **3** | **Fiber Optic Cables** |  |  |  |
| 3.1 | Manufacturer |  |  |  |
| 3.2 | Type of optical fiber cable |  |  |  |
| 3.3 | Number of cores |  |  |  |
| 3.4 | Mode - field diameter at 1550 nm & | µm |  |  |
|  | Mode - field diameter at 1310 nm |  |  |  |
| 3.5 | Effective core area | µm2 |  |  |
| 3.6 | Mode field concentricity error at 1550 nm & | ≤ µm |  |  |
| 3.7 | Mode field concentricity error at 1310 nm |  |  |  |
| 3.8 | Mode field non - circularity error |  |  |  |
| 3.9 | Cut - off wavelength λCC |  |  |  |
| 3.10 | Attenuation coefficient : in 1550 nm & | dB/Km |  |  |
|  | Attenuation coefficient : in 1310 nm |  |  |  |
| 3.11 | 1550 nm bend performance | ≤ db |  |  |
| 3.12 | Non - zero dispersion region | nm |  |  |
| 3.13 | Zero dispersion wavelength | < µm |  |  |
| 3.14 | Cladding diameter | µm |  |  |
| 3.15 | Cladding non - circularity | ≤ % |  |  |
| 3.16 | Primary coating diameter | µm |  |  |
| 3.17 | Primary coating concentricity error | ≤ µm |  |  |
| 3.18 | Primary coating non- circularity error | ≤ % |  |  |
| 3.19 | Fiber materials |  |  |  |
| 3.20 | Fiber coating material |  |  |  |
| 3.21 | Number of armor |  |  |  |
| 3.22 | Material of outer jacket |  |  |  |
| 3.23 | Color coding of fiber |  |  |  |
| 3.24 | Normal drum length | m |  |  |
| 3.25 | Proof stress level | ≥ Gpa |  |  |
| **4** | **Cable Gland** |  |  |  |
| 4.1 | Cable glands |  |  |  |
|  | Manufacturer |  |  |  |
|  | Material |  |  |  |
|  | Type designation |  |  |  |
| **5** | **Cable Tray, Ladder and Accessories** |  |  |  |
| 5.1 | Manufacturer |  |  |  |
|  | Name |  |  |  |
|  | Country |  |  |  |
|  | Type designation |  |  |  |
|  | Standard |  | IEC60228 ASTM B8.B33,IEC 60227 |  |
| 5.2 | Material |  |  |  |
| 5.3 | Galvanized thickness |  |  |  |

# PROTECTION AND INDICATION SYSTEM

## LINE DIFFERENTIAL PROTECTION (87L) RELAY

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (microprocessor based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | V dc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Differential protection requirements |  |  |  |
| 6.1 | Phase segregated protection | Yes/No | Yes |  |
| 6.2 | Ratio and Vector correction for CTs | Yes/No | Yes |  |
| 6.3 | Adjustable biased differential protection characteristic | Yes/No | Yes |  |
| 6.4 | Sensitivity: |  |  |  |
| 6.5 | * For phase faults |  |  |  |
| 6.6 | * For earth faults |  |  |  |
| 6.7 | Operating time | ms | <30 |  |
| 7 | Distance protection requirements |  |  |  |
| 7.1 | Minimum 5 zone ph-ph & ph-E | Yes/No | Yes |  |
| 7.2 | Reverse Zone Capability | Yes/No | Yes |  |
| 7.3 | Phase fault & Earth fault characteristic shapes (Mho, Quad) | Mho, Quad | Mho, Quad |  |
| 7.4 | Operating time | ms | <30ms |  |
| 7.5 | SOTF | Yes/No | Yes |  |
| 7.6 | Power swing blocking (depending on relaying point in the power system) | Yes/No | Yes |  |
| 7.7 | Voltage transformer supervision | Yes/No | Yes |  |
| 7.8 | Time delays for all zones | Yes/No | Yes |  |
| 7.9 | Zone enable/disable for all zones | Yes/No | Yes |  |
| 8 | Other requirements |  |  |  |
| 8.1 | Sensitive Directional Earth Fault 67N | Yes/No | Yes |  |
| 8.2 | DEF comparison function | Yes/No | Yes |  |
| 8.3 | Directional protection 67/67N | Yes/No | Yes |  |
| 8.4 | Overcurrent/Earth fault 50/51/50N/51N | Yes/No | Yes |  |
| 8.5 | Stub protection 50STB | Yes/No | Yes |  |
| 8.6 | Circuit breaker failure. 50BF | Yes/No | yes |  |
| 8.7 | Thermal overload, 49 | Yes/No | Yes |  |
| 8.8 | Auto Reclose 79 (application dependent) | Yes/No | yes |  |
| 8.9 | Over Voltage (59)  Under voltage (27) (At least 3 stages each) | Yes/No | Yes |  |
| 8.10 | Integral inter-trip send and receive, with external input interface | Yes/No | Yes |  |
| 8.11 | Event recording function | Yes/No | Yes |  |
| 8.12 | Disturbance recording function | Yes/No | Yes |  |
| 8.13 | Fault locator function | Yes/No | Yes |  |
| 8.14 | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
| 8.15 | Programmable scheme logic | Yes/No | Yes |  |
| 8.16 | Binary Inputs |  |  |  |
| 8.17 | * Number |  |  |  |
| 8.18 | * Nominal voltage | V dc |  |  |
| 8.19 | * Maximum permissible voltage | V dc |  |  |
| 8.20 | Binary Outputs |  |  |  |
| 8.21 | * Number |  |  |  |
| 8.22 | CT analog inputs |  |  |  |
| 8.23 | * Number |  |  |  |
| 8.24 | * Rated current | A |  |  |
| 8.25 | * Power consumption | VA |  |  |
| 8.26 | VT analog inputs |  |  |  |
| 8.27 | * Number |  |  |  |
| 8.28 | * Rated voltage | Vac |  |  |
| 8.29 | * Power consumption | VA |  |  |
| 8.30 | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No |  |  |
| 8.31 | * Programme name | Yes |  |  |
| 8.32 | * Program included in delivery | Yes/No |  |  |
| 8.33 | * Type of interface at relay (e.g. RS232, Ethernet) | Yes |  |  |
| 8.34 | Tripping contacts rating | yes |  |  |
| 8.35 | * Carry continuous | A | 5 |  |
| 8.36 | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
| 8.37 | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
| 8.38 | Self-monitoring and alarm facility | Yes/No | Yes |  |
| 9 | Communications |  |  |  |
| 9.1 | Protection |  |  |  |
| 9.2 | Direct optical fibre |  |  |  |
| 9.3 | * 1550nm single mode distance (km) | Yes/No |  |  |
| 9.4 | * 1300nm single mode distance (km) | Yes/No |  |  |
| 9.5 | * 820nm multimode distance (km) | Yes/No |  |  |
| 9.6 | Others supported |  |  |  |
| 9.7 | * G703.1 | Yes/No |  |  |
| 9.8 | * X21 | Yes/No |  |  |
| 9.9 | * IEEE C37.94 | Yes/No |  |  |
| 9.10 | Control |  |  |  |
| 9.11 | Communication ports (Front/Rear etc.) |  |  |  |
| 9.12 | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
| 9.13 | Protocols supported |  |  |  |
| 9.14 | * IEC 61850 | Yes/No | Yes |  |
| 9.15 | * Others (please state) |  |  |  |
| 9.16 | Type Tests -not older than 5 years | Yes/No | Yes. Type test Certificate/Report |  |
| 9.16 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 10 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 11 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 12 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 13 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 14 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 15 | Type test certificate provided not older than 5 years | Yes/No | Yes |  |
| 16 | Mean Time Between Failure | Years | 15 |  |
| 17 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## DISTANCE (21L) RELAY

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (microprocessor based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Distance protection requirements |  |  |  |
|  | Minimum 5 zone ph- ph & ph-E | Yes/No | Yes |  |
|  | Reverse Zone Capability | Yes/No | Yes |  |
|  | Phase fault & Earth fault characteristic shapes | Mho, Quad | Mho, Quad |  |
|  | Nominal Z1 Operating time | ms | <30 |  |
|  | SOTF | Yes/No | Yes |  |
|  | Power swing blocking | Yes/No | Yes |  |
|  | Voltage transformer supervision | Yes/No | Yes |  |
|  | Time delays for all zones | Yes/No | Yes |  |
|  | Zone enable/disable for all zones | Yes/No | Yes |  |
|  | Main line distance protection (21- 1/L) | Yes/No | Yes |  |
|  | Backup line distance protection (21-2/L) | Yes/No | Yes |  |
| 7 | Other supported functions |  |  |  |
|  | Sensitive Directional Earth Fault 67N | Yes/No | Yes |  |
|  | DEF comparison function | Yes/No | Yes |  |
|  | Directional protection 67/67N | Yes/No | Yes |  |
|  | Overcurrent/Earth fault 50/51/50N/51N | Yes/No | Yes |  |
|  | Stub protection 50STB | Yes/No | Yes |  |
|  | Circuit breaker failure. 50BF- (application dependent) | Yes/No | Yes |  |
|  | Thermal overload, 49 | Yes/No | Yes |  |
|  | Auto Reclose 79 (application dependent) | Yes/No | No |  |
|  | Over Voltage (59)  Under voltage (27) (At least 3 stages each) | Yes/No | Yes |  |
|  | Integral inter trip send and receive, with external input interface | Yes/No | Yes |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No | Yes |  |
|  | Fault locator function | Yes/No | Yes |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No |  |  |
|  | * Type of interface at relay (e.g. RS232, Ethernet) |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | Test switches for current and voltage | Yes/No | Yes |  |
|  | Test switches for dc circuits | Yes/No | Yes |  |
| 8 | Communications |  |  |  |
| 8.1 | Protection |  |  |  |
|  | Direct optical fibre |  |  |  |
|  | * 1550nm single mode distance (km) | Yes/No |  |  |
|  | * 1300nm single mode distance (km) | Yes/No |  |  |
|  | * 820nm multi-mode distance (km) | Yes/No |  |  |
|  | Others supported |  |  |  |
|  | * G703.1 | Yes/No |  |  |
|  | * X21 | Yes/No |  |  |
|  | * IEEE C37.94 | Yes/No |  |  |
| 8.2 | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 9 | Type Tests |  |  |  |
| 9.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 9.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 9.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 9.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 9.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 9.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test, IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 9.7 | Type test certificate provided | Yes/No | Yes |  |
| 9.8 | Mean Time Between Failure | Years | 15 |  |
| 9.9 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## MAIN TRANSFORMER DIFFERENTIAL PROTECTION RELAY (87 HVC1 & HVC2)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (microprocessor based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | V dc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Biased differential function |  |  |  |
|  | Operation time at 5 times setting | ms | <25 |  |
|  | Adjustable bias characteristics | Yes/No | Yes |  |
|  | Differential current stage Id >> | Yes/No | Yes |  |
|  | Magnetisation inrush restraint | Yes/No | Yes |  |
|  | 5th” Harmonic restraint | Yes/No | Yes |  |
|  | CT ratio and vector group compensation | Yes/No | Yes |  |
|  | STUB protection function (87STUB) | Yes/No | Yes |  |
| 7 | Restricted earth fault function (64T) | Yes/No | Yes |  |
|  | HV REF | Yes/No | Yes |  |
|  | Principle of REF operation |  |  |  |
|  | High impedance/Low impedance |  | Low |  |
|  | Operation time at 5 times settings | ms | <30 |  |
| 8 | Other requirements |  |  |  |
|  | Tertiary Neutral overcurrent function 51NTV | Yes/No | Yes |  |
|  | Tertiary Neutral Differential protection 87NTV | Yes/No | Yes |  |
|  | Over flux protection 24 | Yes/No | Yes |  |
|  | Thermal overload protection 49 | Yes/No | Yes |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | V dc | 110 |  |
|  | * Maximum permissible voltage | V dc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g. RS232, Ethernet) |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No | Yes |  |
|  | Fault recording function | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
| 9 | Communications |  |  |  |
| 9.1 | Control |  |  |  |
|  | Communication ports (Front/ Rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 10 | Type Tests |  |  |  |
| 10.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 10.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 10.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 10.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 10.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests   IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 10.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 10.7 | Type test certificate provided | Yes/No | Yes |  |
| 10.8 | Mean Time Between Failure | Years | 15 |  |
| 10.9 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## MAIN TRANSFORMER/REACTOR DIFFERENTIAL PROTECTION (87T/87R)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (microprocessor based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Principle of operation |  |  |  |
|  | * High impedance/Low impedance | High or Low |  |  |
| 7 | Biased differential function (Low Impedance) |  |  |  |
|  | No of separate CT inputs |  | 3 |  |
|  | Operation time at 5 times setting | ms | <25 |  |
|  | Adjustable bias characteristics | Yes/No | Yes |  |
|  | Differential current stage Id >> | Yes/No | Yes |  |
|  | Magnetisation inrush restraint | Yes/No | Yes |  |
|  | 5th” Harmonic restraint | Yes/No | Yes |  |
|  | CT ratio and vector group compensation | Yes/No | Yes |  |
| 8 | Differential function (Low Impedance) |  |  |  |
|  | Minimum fault setting (% of CT rating) | % |  |  |
|  | Operating time at 5 x setting | ms | <30 |  |
|  | Non Linear Resistors (Metrosils) integral | No | No |  |
| 9 | Other functions |  |  |  |
|  | Neutral Differential protection (87NR) | Yes/No | Yes |  |
|  | Overcurrent / Earth fault (50/51/50N/51N) | Yes/No | Yes |  |
| 10 | Other requirements |  |  |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g. RS232, Ethernet) |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No | Yes |  |
|  | Fault recording function | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | Mechanical protection signalling and tripping relays (63) | Yes/No | Yes |  |
|  | Test switches for current and voltage | Yes/No | Yes |  |
|  | Test switches for dc circuits | Yes/No | Yes |  |
| 11 | Communications |  |  |  |
| 11.1 | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 12 | Type Tests |  |  |  |
| 12.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 12.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 12.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 12.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump, IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 12.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests   IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 12.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 12.7 | Type test certificate provided will not be older than 5 years | Yes/No | Yes. Type test Certificate/Report |  |
| 12.8 | Mean time between failure | Years | 15 |  |
| 12.9 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## LOW IMPEDANCE BUSBAR PROTECTION SYTEM

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (static, microprocessor-based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | State principle of operation, i.e., low impedance |  | Low Z |  |
| 7 | Integral check zone feature | Yes/No | Yes |  |
| 8 | Centralized or Distributed with Bay Modules | Centre. or distributed | Distributed type |  |
| 9 | Maximum number of Bays |  | As per single line diagram |  |
| 10 | CT saturation detector and stabilisation | Yes/No | Yes |  |
| 11 | Integral CT supervision | Yes/No | Yes |  |
| 12 | CT matching functions | Yes/No |  |  |
| 13 | Phase segregated protection | Yes/No |  |  |
| 14 | Sensitivity |  |  |  |
|  | * Phase faults | A sec’y |  |  |
|  | * Earth faults | A sec’y |  |  |
|  |  |  |  |  |
| 15 | Operating time at 5 x fault setting | ms | 30 |  |
| 16 | Two stage circuit breaker failure | Yes/No | Yes |  |
| 17 | Adjustable current setting | Yes/No | Yes |  |
| 18 | Adjustable time delays per stage | Yes/No | Yes |  |
| 19 | Breaker failure function (50BF) | Yes/No | Yes |  |
| 20 | End zone (fault) protection function | Yes/No | Yes |  |
| 21 | Other requirements |  |  |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | PC based configuration software for HMI, settings, logic, and data recorder. |  |  |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g., RS232, Ethernet) |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
| 22 | Communications |  |  |  |
| 22.1 | Bay to central Module communication |  | Fibre optic |  |
| 22.2 | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 23 | Type Tests |  |  |  |
| 23.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 23.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 23.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 23.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 23.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests   IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 23.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 23.7 | Type test certificate provided | Yes/No | Yes |  |
| 23.8 | Enough spare capacity for future bays | Yes/No | Yes |  |
| 23.9 | Mean Time Between Failure | Years | 15 |  |
| 23.10 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## OVERCURRENT & EARTH FAULT PROTECTION

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Relay design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| .5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Number of phase CT inputs |  |  |  |
| 7 | Number of earth fault CT inputs |  |  |  |
| 8 | Characteristics curves conforming to IEC 60255, ANSI | Yes/No | Yes |  |
| 9 | Number of overcurrent functions (e.g. No. lowset, high set, IDMTL) |  |  |  |
| 10 | Number of earth fault functions |  |  |  |
| 11 | Number of group settings |  |  |  |
| 12 | Earth fault element suitable of high impedance REF (with external resistor) | Yes/No | Yes |  |
| 13 | Other functions provided |  |  |  |
|  | * Breaker Failure 50BF | Yes/No |  |  |
|  | * Thermal overload 49 | Yes/No |  |  |
| 14 | Other Requirements |  |  |  |
|  | Integral metering functions | Yes/No |  |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | Event and Fault recording functions | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | PC based configuration software for HMI, settings, logic, and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g., RS232, Ethernet) |  |  |  |
| 10.6.15 | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
| 16 | Communications |  |  |  |
| 16.1 | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 17 | Type Tests |  |  |  |
| 17.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 17.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 17.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 17.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 17.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric test – IEC 60255-5 - Series IEC 60255-5– Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 17.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions   IEC 60255-25 | Yes/No | Yes |  |
|  | Fast Transient Disturbance IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 17.7 | Type test certificate provided | Yes/No | Yes. Type test Certificate/Report To be enclosed with bid |  |
| 17.8 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## POINT ON WAVE SWITCHING DEVICE

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type |  |  |  |
| 3 | Device design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 5 | CT analog inputs |  |  |  |
|  | * Number |  | 3 |  |
|  | * Rated current | A | 1 |  |
|  | * Thermal withstand capability continuously | A |  |  |
|  | * Thermal withstand capability for 1s | A |  |  |
|  | * Thermal withstand capability for 10s | A |  |  |
|  | * Power consumption | VA |  |  |
|  | * Input frequency range (50Hz nominal) | Hz | 16→66 |  |
| 6 | VT analog inputs |  |  |  |
|  | * Number |  | 3 |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Voltage withstand continuously | Vac |  |  |
|  | * Voltage withstand for 10s | Vac |  |  |
|  | * Power consumption | VA |  |  |
|  | * Input frequency range (50Hz nominal) | Hz | 16→66 |  |
| 7 | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
| 8 | Outputs |  |  |  |
|  | * Number |  |  |  |
|  | * Continuous contact carry | A |  |  |
|  | * Make and carry for 3.0 s | A |  |  |
|  | * Make and carry for 0.5 s | A |  |  |
|  | * Breaking capacity when the control-circuit time constant is L/R=40 ms, at U = 110 V DC | A |  |  |
| 9 | Circuit breaker operation | Three pole/ Single-pole | Single-pole |  |
| 10 | Opening operation | Yes/No | Yes |  |
| 11 | Closing operation | Yes/No | Yes |  |
| 12 | Programmable logic | Yes/No | Yes |  |
| 13 | Event and Fault recording functions | Yes/No | Yes |  |
| 14 | Self-monitoring and alarm facility | Yes/No | Yes |  |
| 15 | PC based configuration software for HMI, settings, logic and data recorder | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Included in delivery | Yes/No | Yes |  |
| 16 | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
| 17 | Local interface for PC connection | Yes/No | Yes |  |
|  | * Communication ports (Front/rear etc.) |  |  |  |
|  | * Physical links (RS232/Ethernet) |  |  |  |
| 18 | Remote Control and Monitoring |  |  |  |
|  | * Communication ports (Front/rear etc.) |  | Rear |  |
|  | * Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | * Protocol |  | IEC 61850 |  |
| 19 | Type Tests |  |  |  |
| 19.1 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 19.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 19.3 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 19.4 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 19.5 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 19.6 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 19.7 | Type test certificate provided. Not older than 5years | Yes/No | Yes. Type test Certificate/Report To be enclosed with bid |  |

## MERGING UNIT (MU)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 6 | Merging Unit requirements |  |  |  |
|  | CT analog inputs |  |  |  |
|  | Number |  |  |  |
|  | Rated current | A | 1 |  |
|  | Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | Number |  |  |  |
|  | Rated voltage | Vac | 110 |  |
|  | Number of SV streams output supported |  |  |  |
|  | Protocol SV output |  | IEC61850 or  IEC61869-9 |  |
|  | Network redundancy SV output |  | IEC 62439 - PRP |  |
|  | Output Interface |  | 1000Base-FX |  |
|  | Interface Station Bus/Management |  |  |  |
|  | Protocols management |  |  |  |
|  | Clock Synchronization | - | IEC/IEEE 61850-9-3:2016 - Power Utility Profile |  |
|  | Holdover time | seg | 30 |  |
| 7 | Other functions |  |  |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No |  |  |
|  | Fault locator function | Yes/No |  |  |
|  | Integral LCD operator interface for local interrogation | Yes/No |  |  |
|  | Programmable logic | Yes/No |  |  |
|  | Binary Inputs |  |  |  |
|  | Number |  |  |  |
|  | Nominal voltage | Vdc | 110 |  |
|  | Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | Number |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | Carry continuous | A | 5 |  |
|  | Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | * Power consumption | VA |  |  |
|  | * PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | Program included in delivery | Yes/No | Yes |  |
|  | * Self-monitoring and alarm facility | Yes/No | Yes |  |
| 8 | Type Tests |  |  |  |
| 8.1 | * Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 8.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 8.3 | * Enclosure |  |  |  |
|  | IEC 60529 |  | IP50 |  |
| 8.4 | * Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 8.5 | * Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | * 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 8.6 | * Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test, IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge * IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions * IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance * IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 8.7 | * Type test certificate provided | Yes/No | Yes |  |
| 8.8 | Mean Time Between Failure | Years | 15 |  |
| 8.9 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

## SWITCH CONTROLLER UNIT (SCU)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
| 3 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| 4 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 5 | SCU requirements |  |  |  |
|  | Binary Inputs |  |  |  |
|  | Number |  |  |  |
|  | Nominal voltage | Vdc | 110 |  |
|  | Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | Number |  |  |  |
|  | Tripping contacts rating |  |  |  |
|  | Carry continuous | A | 5 |  |
|  | Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
|  | Protocol output Process Bus |  | IEC61850-8-1 GOOSE |  |
|  | Network redundancy output Process Bus |  | IEC 62439 - PRP |  |
|  | Output Interface Process Bus |  | 1000Base-FX |  |
|  | Clock Synchronization Process Bus interface | - | IEC/IEEE 61850-9-3:2016 - Power Utility Profile |  |
|  | Protocol output Station Bus |  | IEC61850-8-1 GOOSE and Client/Server |  |
|  | Network redundancy output Station Bus |  | IEC 62439 - PRP |  |
|  | Output Interface Station Bus |  | 1000Base-FX |  |
|  | Protocols management |  |  |  |
|  | Clock Synchronization Station Bus Interface (if not available in the Process Bus) | - | IEC/IEEE 61850-9-3:2016 - Power Utility Profile |  |
|  | Holdover time | seg | 30 |  |
|  | IEC61850 Test mode (Ed 2.0) options |  | On, Test, Test Blocked |  |
|  | IEC61850 Test mode (Ed 2.0) controllable via Client/Server commands |  | Yes |  |
|  | IEC61850 LPHD.Sim (Ed2.0) controllable via Client/Server commands |  | Yes |  |
|  | GOOSE subscription supervision via LGOS |  | Yes |  |
| 6 | Other functions |  |  |  |
|  | Event recording function | Yes/No | Yes |  |
|  | Disturbance recording function | Yes/No |  |  |
|  | Integral LCD operator interface for local interrogation | Yes/No |  |  |
|  | Programmable logic | Yes/No |  |  |
|  | * Power consumption | VA |  |  |
|  | * PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | Program included in delivery | Yes/No | Yes |  |
|  | * Self-monitoring and alarm facility | Yes/No | Yes |  |
| 7 | Type Tests |  |  |  |
| 7.1 | * Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 7.2 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 7.3 | * Enclosure |  |  |  |
|  | IEC 60529 |  | IP50 |  |
| 7.4 | * Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 7.5 | * Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | * 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 7.6 | * Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test, IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge * IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions * IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance * IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 7.7 | * Type test certificate provided | Yes/No | Yes |  |
| 7.8 | Mean Time Between Failure | Years | 15 |  |
| 7.9 | Dual Independent fiber optic ethernet ports | Yes/No | Yes |  |

# TARIFF METERING SYSTEM

## TARIFF METER (main and check meter)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer |  |  |  |
| 2 | Model |  |  |  |
| 3 | Construction |  |  |  |
|  | * Measuring Principle |  | 3ph, 4wire |  |
|  | * Type |  | Numerical |  |
|  | * Display/Reading digits |  | ≥7 |  |
|  | * Backlit LCD |  | Yes |  |
| 4 | Auxiliary voltage range |  |  |  |
|  | * DC (Vn = 110Vdc) | Vdc | 88→125 |  |
|  | * AC | Vac | 230 |  |
| 5 | CT analog inputs |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Current measuring range | pu | 1.2 |  |
|  | * Power consumption (burden) | VA | To be enclosed with bid |  |
| 6 | VT analog inputs |  |  |  |
|  | * Rated voltage | V | 110 |  |
|  | * Voltage measuring range | pu | 0.8 – 1.15 |  |
|  | * Power consumption (burden) | VA |  |  |
| 7 | Accuracy Class |  |  |  |
|  | * Watt hour (IEC 602053-22 & IEC 602053-23) |  | 0.2s |  |
|  | * VAr hour (IEC 602053-22 & IEC 602053-23) |  | 2.0 |  |
| 8 | Measurements |  |  |  |
|  | * kWh, kVArh | Yes/No | Yes |  |
|  | * kW, kVAr | Yes/No | Yes |  |
|  | * V, I | Yes/No | Yes |  |
|  | * Four quadrant reactive energy | Yes/No | Yes |  |
|  | * Max Demand | Yes/No | Yes |  |
|  | * THD | Yes/No | Yes |  |
| 9 | Outputs |  |  |  |
|  | * Pulsed Outputs (IEC 62053-31) |  | 3 (min) |  |
| 10 | Data Logging |  |  |  |
|  | * Integral Logging/Storage function |  |  |  |
|  | Duration | days | 180 |  |
|  | Channels |  | 4 |  |
|  | Programmable Periods | Yes/No | Yes |  |
|  | * Inputs from external meters | Yes/No |  |  |
| 11 | Other functions |  |  |  |
|  | * Battery Back-up | Yes/No | Yes |  |
|  | * Back-up duration | days | ≥14 |  |
|  | * GPS clock | Yes/No | Yes |  |
|  | * Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | * Dual supply changeover (VT) | Yes/No | Yes |  |
| 12 | Communications |  |  |  |
|  | * Communication ports (Front/rear etc.) |  |  |  |
|  | RS232 | Yes/No |  |  |
|  | RS485 | Yes/No | Yes |  |
|  | Optical (IEC 62056-21) | Yes/No | Yes |  |
|  | Ethernet-IEC 61850 | Yes/No | Yes |  |
|  | * Protocols supported |  |  |  |
|  | IEC 62056-21, DLMS | Yes/No | Yes |  |
|  | IEC 61850 | Yes/No | Yes |  |
|  | Others (please list) |  |  |  |
| 13 | Type Tests |  |  |  |
| 14 | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 15 | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 16 | Enclosure |  |  |  |
|  | * IEC 60529 |  | IP50 |  |
| 17 | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 18 | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 19 | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test, IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 20 | Type test certificate provided. Not older than 5years. | Yes/No | Yes |  |

# FAULT RECORDING AND PHASOR MEASUREMENT

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | **FAULT RECORDING SYSTEM** |  |  |  |
| 1 | Manufacturer |  |  |  |
| 2 | Type reference |  |  |  |
|  | DAU unit type |  |  |  |
|  | Master Station type |  |  |  |
|  | HMI type |  |  |  |
|  | Printer type |  |  |  |
| 3 | Auxiliary voltage range (Vn = 110Vdc) | Vdc |  |  |
| 4 | Analogue Inputs |  |  |  |
| 5 | Binary inputs |  |  |  |
| 6 | A/D converter | bit |  |  |
| 7 | Current input max amplitude | In |  |  |
| 8 | Current/voltage accuracy | % fsd | ≤0.5 |  |
| 9 | Scan Rate |  |  |  |
|  | Analogue Channel | Hz | ≥4000 |  |
|  | Event Channel | Hz | ≥2000 |  |
| 10 | Time stamp resolution | ms | 1 |  |
| 11 | Recording range |  |  |  |
|  | Pre-Fault | ms | ≥500 |  |
|  | Post Fault | ms | ≥2000 |  |
| 12 | Trigger response time |  |  |  |
| 13. | **FAULT MONITORING SYSTEM** |  |  |  |
| 13.1 | Manufacturer |  |  |  |
| 13.2 | Type reference |  |  |  |
|  | DAU unit type |  |  |  |
|  | Master Station type |  |  |  |
|  | HMI type |  |  |  |
|  | Printer type |  |  |  |
| 13.3 | Auxiliary voltage range (Vn = 110Vdc) | Vdc |  |  |
| 13.4 | Analogue Inputs |  |  |  |
| 13.5 | Binary inputs |  |  |  |
| 13.6 | A/D converter | bit |  |  |
| 13.7 | Current input max amplitude | In |  |  |
| 13.8 | Current/voltage accuracy | % fsd | ≤0.5 |  |
| 13.9 | Scan Rate |  |  |  |
|  | Analogue Channel | Hz | ≥4000 |  |
|  | Event Channel | Hz | ≥2000 |  |
| 13.10 | Time stamp resolution | ms | 1 |  |
| 13.11 | Recording range |  |  |  |
|  | Pre-Fault | ms | ≥500 |  |
|  | Post Fault | ms | ≥2000 |  |
| 13.12 | Trigger response time |  |  |  |
|  | Printer type |  |  |  |
|  | Analogue | ms |  |  |
|  | Event | ms |  |  |
| 13.13 | Memory |  |  |  |
|  | RAM (Non-Volatile) | GB | >8 |  |
|  | HDD | Terabyte | >1 |  |
| 13.14 | Battery back-up duration | days | ≥14 |  |
| 13.15 | GPS clock input | Yes/No | Yes |  |
| 13.16 | System software |  |  |  |
| 13.17 | Self-monitoring and alarm facility | Yes/No | Yes |  |
| 13.18 | Communications |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | RS232 | Yes/No |  |  |
|  | RS485 | Yes/No |  |  |
|  | RJ45 | Yes/No |  |  |
|  | Other | Yes/No |  |  |
|  | Protocols supported |  |  |  |
|  | IEC 61850 | Yes/No |  |  |
|  | Others (please list) |  |  |  |
|  | Graphical data presentation on SCADA HMI | Yes/No | Yes |  |
| 13.19 | Type Tests |  |  |  |
| 13.19.1 | Atmospheric Environment |  |  |  |
|  | Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
| 13.19.2 | Relative Humidity |  |  |  |
|  | Operation at 93% | Yes/No | Yes |  |
|  | Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
| 13.19.3 | Enclosure |  |  |  |
|  | IEC 60529 |  | IP50 |  |
| 13.19.4 | Mechanical Environment |  |  |  |
|  | Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | Seismic IEC 60255-21-3 | Yes/No | Yes |  |
| 13.19.5 | Insulation |  |  |  |
|  | Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | Dielectric Tests  IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage  IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
| 13.19.6 | Electromagnetic compatibility |  |  |  |
|  | 1MHz Burst disturbance test,  IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | Electrostatic Discharge  IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | Radiated Electromagnetic Field Disturbance  IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | Electromagnetic Emissions  IEC 60255-25 | Yes/No | Yes |  |
|  | Fast Transient Disturbance  IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
| 13.19.7 | Type test certificate provided | Yes/No | Yes |  |
| 14. | **PHASOR MEASUREMENT UNIT** |  |  |  |
| 14.1 | Applicable Standards |  | IEEE C37.118  IEC 61850 |  |
| 14.2 | Environmental Conditions |  |  |  |
| 14.3 | Working Temperature | ⁰C |  |  |
| 14.4 | Storage Temperature | ⁰C |  |  |
| 14.5 | Maximum Humidity | % | < 90% |  |
| 14.6 | Type |  |  |  |
| 14.7 | GPS Clock |  |  |  |
| 14.8 | Ethernet Switch |  |  |  |
| 14.9 | Industrial PC 4U Rack |  |  |  |
| 14.10 | Laser Printer |  |  |  |
| 14.11 | LED Monitor+Keyborad+Mouse |  |  |  |
| 14.12 | Model |  |  |  |
| 15 | Phasor Measurement Unit |  |  |  |
| 15.1 | GPS Clock |  |  |  |
| 15.2 | Ethernet Switch |  |  |  |
| 15.3 | Industrial PC 4U Rack |  |  |  |
| 15.4 | Laser Printer |  |  |  |
| 15.5 | LED Monitor+Keyborad+Mouse |  |  |  |
| 15.6 | Make |  |  |  |
| 15.7 | Cabinet |  |  |  |
| 15.8 | Mounting |  |  |  |
| 15.9 | Case type |  |  |  |
| 15.9 | IP degree |  |  |  |
| 15.10 | Weight |  |  |  |
| 15.11 | Dimensions in mm (w x h x l) |  |  |  |
| 15.12 | Isolation withstand |  |  |  |
| 15.13 | Fan | Yes/No |  |  |
| 15.14 | AC Socket | Yes/No |  |  |
| 15.15 | Fuses | Yes/No |  |  |
| 15.16 | Terminals with Labels | Yes/No |  |  |
| 15.17 | Wire Marks | Yes/No |  |  |
| 15.18 | Door Micro Switch | Yes/No |  |  |
| 15.19 | Swing Door Lock | Yes/No |  |  |
| 15.20 | Lighting | Yes/No |  |  |
| 15.21 | Loop Test Switch | Yes/No |  |  |
| 15.22 | Thermostat | Yes/No |  |  |
| 16 | PMU |  |  |  |
| 16.1 | Power Supply Unit |  |  |  |
| 16.2 | Central Processor Unit board |  |  |  |
| 16.3 | Digital Signal Processing board |  |  |  |
| 16.4 | Backplain board |  |  |  |
| 16.5 | Network interface board |  |  |  |
| 16.6 | Analog acquisition board |  |  |  |
| 16.7 | Digital inputs and alarm board |  |  |  |
| 16.8 | RS232 serial links |  |  |  |
| 16.9 | RJ45 Copper Ethernet links |  |  |  |
| 16.10 | Internal GPS / External GPS |  |  |  |
| 16.11 | GPS ports |  |  |  |
| 16.12 | Memory Type and Capacity |  |  |  |
| 16.13 | Current Inputs Board |  |  |  |
| 16.14 | Voltage Inputs Board |  |  |  |
| 16.15 | Digital inputs Board |  |  |  |
| 16.16 | System bus interface/speed |  |  |  |
| 16.17 | Provision of two redundant interfaces to LANs |  |  |  |
| 16.18 | Test block /test plug for secondary injection test |  |  |  |
| 16.19 | Data measurement/calculation such as V,I,F, ROCOF, P ,Q , Wh , Varh, power factor, THD ,harmonics up to 11th , … |  |  |  |
| 16.20 | Time tag accuracy |  |  |  |
| 16.21 | Support class | P |  |  |
| 16.22 | Reporting rate | Frame /sec | 60 |  |
| 16.23 | Rated voltage | V |  |  |
| 16.24 | Rated current | A |  |  |
| 16.25 | Nominal frequency | Hz | 50 |  |
| 16.26 | Operating frequency | Hz | 45-55 |  |
| 16.27 | Auxiliary DC Voltage | V DC |  |  |
| 12.7.28 | Auxiliary AC Voltage | V AC |  |  |
| 16.29 | Power consumption | W |  |  |
| 16.30 | Total Vector Error (TVE) |  | <1% |  |
| 16.31 | Number of analog channels for synchrophasor measurement |  |  |  |
| 16.32 | Number of opto – insolated digital channels voltage range 24-240 |  |  |  |
| 16.33 | Number of digital output contacts |  |  |  |
| 16.34 | Digital output contacts making/breaking capacity for DC with DR<40 ms |  |  |  |
| 16.35 | Voltage measuring rang | V |  |  |
| 16.36 | Over voltage capability | V |  |  |
| 16.37 | Current measuring range | A |  |  |
| 16.38 | Over current capability | A | 100A, 1Sec |  |
| 16.39 | Min voltage measurement resolution /accuracy |  |  |  |
| 16.40 | Phase measurement accuracy |  |  |  |
| 17 | Time synchronization (GPS) |  |  |  |
| 17.1 | Type |  |  |  |
| 17.2 | Internal GPS card/External GPS |  |  |  |
| 17.3 | AC/DC voltage working range | V |  |  |
| 17.4 | Power consumption | W |  |  |
| 17.5 | Battery standby |  |  |  |
| 17.6 | Type, speed and no. of output interfaces |  |  |  |
| 17.7 | Time and data facility |  |  |  |
| 17.8 | Local time compensation |  |  |  |
| 17.9 | Seasonal changeover/automatic |  |  |  |
| 17.10 | Synchronizing time accuracy | 1µs |  |  |
| 17.11 | GPS ports |  |  |  |
| 17.12 | GPS Antenna type |  |  |  |
| 17. 13 | GPS antenna connector type |  |  |  |
| 17.14 | Cable length and type |  |  |  |
| 18 | Analog to Digital converter |  |  |  |
| 18.1 | Model |  |  |  |
| 18.2 | Maximum no inputs per card |  |  |  |
| 18.3 | Outputs available per input |  |  |  |
| 18.4 | Resolution/accuracy |  |  |  |
| 18.5 | Sampling rate |  |  |  |
| 18.6 | Burden | VA |  |  |
| 18.7 | Input CT/VT range |  |  |  |
| 18.8 | Analogue limit monitoring facility at PMU |  |  |  |
| 18.9 | No of input analog quantity per board |  |  |  |
| 18.10 | Digital inputs |  |  |  |
| 18.11 | Number of inputs |  |  |  |
| 18.12 | Rated nominal voltage | V |  |  |
| 18.13 | Operating range | V |  |  |
| 18.14 | Digital/software filtering to suppress plant contact |  |  |  |
| 18.15 | Maximum input contact frequency |  |  |  |
| 18.16 | Minimum contact closure capture time |  |  |  |
| 18.17 | Time tagging resolution |  |  |  |
| 18.18 | Isolation withstand |  |  |  |
| 19 | Digital outputs |  |  |  |
| 19.1 | Number of outputs |  |  |  |
| 19.2 | Rated nominal voltage | V |  |  |
| 19.3 | Operating range | V |  |  |
| 19.4 | Double pole switching of output |  |  |  |
| 12.11 | Software |  |  |  |
| 19.1 | Monitoring and configuration software |  |  |  |
| 19.2 | Configure all PMU parameters by connecting directly (local /remote) |  |  |  |
| 19.3 | Adding /relocation/rename of PMUs and feeders. |  |  |  |
| 19.4 | Deliver real time measurement and real time waveforms and harmonic up to 11th V ,I , F, E, P , Q, angle difference. |  |  |  |
| 19.5 | Event monitoring |  |  |  |
| 19.6 | Recording and download |  |  |  |
| 19.7 | Installation utility |  |  |  |
| 19.8 | Network server configuration |  |  |  |
| 19.9 | Communication configuration |  |  |  |
| 19.10 | Dynamic Analyzer software |  |  |  |
| 19.11 | Recording software |  |  |  |
| 19.12 | Self-monitoring and problem reporting /alarming |  |  |  |
| 19.13 | Security requirements |  |  |  |
| 20 | WAMPAC infrastructure |  |  |  |
| 20.1 | Interface type for Ethernet communication |  |  |  |
| 20.2 | Supported protocol |  |  |  |
| 20.3 | Number of normally open contacts |  |  |  |
| 21 | Communication to PDC |  |  |  |
| 21.1 | Compliant with IEEE C37.118 |  |  |  |
| 21.2 | Communication mode |  |  |  |
| 21.3 | Media |  |  |  |
| 21.4 | Type of ports |  |  |  |
| 21.5 | Transfer rate |  |  |  |
| 22 | Communication to Control Centers |  |  |  |
| 22.1 | Compliant with IEEE C37.118 |  |  |  |
| 22.2 | Communication mode |  |  |  |
| 22.3 | Media |  |  |  |
| 22.4 | Type of ports |  |  |  |
| 22.5 | Transfer rate |  |  |  |

# SUBSTATION CONTROL SYSTEM

| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| **1** | **Substation Computer** |  |  |  |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Model |  |  |  |
| 1.3 | Processor |  |  |  |
|  | * Type |  |  |  |
|  | * Word length | Bits |  |  |
|  | * Clock speed (minimum) | GHz | 3 |  |
| 1.4 | Memory size | GB |  |  |
|  | * Supplied (minimum) | GB | 8 |  |
|  | * Supportable/expandable | GB |  |  |
| 1.5 | Hard disk size (non-rotating) | Tera Byte |  |  |
|  | * Supplied (minimum) | GB | 8 |  |
|  | * Supportable/expandable | GB |  |  |
| 1.6 | Optical Storage | Yes/No |  |  |
| 1.7 | Operating system |  |  |  |
| 1.8 | Software supplied |  |  |  |
| 1.9 | Operating temperature range | °C |  |  |
| 1.10 | Maximum relative humidity | % |  |  |
| 1.11 | Nominal voltage | Vac | 240 |  |
| 1.12 | Operating frequency | Hz | 50 |  |
| 1.13 | Starting current | A |  |  |
| 1.14 | Power requirement | W |  |  |
| 1.15 | Mean time between failure | Years | 15 |  |
| 1.16 | Mean time to repair | h | 96 |  |
| **2** | **Gateway** |  |  |  |
| 2.1 | Manufacturer |  |  |  |
| 2.2 | Model |  |  |  |
| 2.3 | Processor |  |  |  |
|  | * Type |  |  |  |
|  | * Word length | Bits |  |  |
|  | * Clock speed (minimum) | GHz | 3 |  |
| 2.4 | Memory size | GB |  |  |
|  | * Supplied (minimum) | GB | 16 |  |
|  | * Supportable/expandable | GB |  |  |
| 2.5 | Hard disk size | TB |  |  |
|  | * Supplied (minimum) | GB |  |  |
|  | * Supportable/expandable | GB |  |  |
| 2.6 | Communication Protocols To Control Centre(s) |  |  |  |
|  | * NCC Main IEC 60870-5-104 | Yes/No | Yes |  |
|  | * NCC Alt IEC 60870-5-104 | Yes/No | Yes |  |
|  | * NCC TCP/IP Intranet | Yes/No | Yes |  |
|  | * RCC Main IEC 60870-5-104 | Yes/No | Yes |  |
|  | * RCC Alt IEC 60870-5-104 | Yes/No | Yes |  |
|  | * NCC IEC 60870-5-104 | Yes/No | Yes |  |
|  | * RCC IEC 60870-5-104 | Yes/No | Yes |  |
| 2.7 | Communication Protocols in Substation |  |  |  |
|  | * IEC 61850 Ed 2.1 | Yes/No | Yes |  |
| 2.8 | List other operating Protocols |  |  |  |
| 2.9 | Data Communications Interface |  |  |  |
|  | * Ethernet 100Base-T | Yes/No | Yes |  |
|  | * Ethernet 1000Base-T | Yes/No | Yes |  |
|  | * Redundant communication port | Yes/No | Yes |  |
|  | * Redundancy IEC 62439 - PRP | Yes/No |  |  |
| .2.10 | Operating system |  |  |  |
| 2.11 | Operating temperature range | °C |  |  |
| 2.12 | Maximum relative humidity | % |  |  |
| 2.13 | Nominal voltage | Vdc |  |  |
| 2.14 | Operating frequency | Hz |  |  |
| 2.15 | Starting current | A |  |  |
| 2.16 | Power requirement | W |  |  |
| 2.17 | Mean time between failure | Years | 15 |  |
| 2.18 | Mean time to repair | h | 96 |  |
| **3** | **Operator Workstations / HMI** |  |  |  |
| 3.1 | Manufacturer |  |  |  |
| 3.2 | Model |  |  |  |
| 3.3 | Literature reference for principle of operation | Yes/No | Yes |  |
| 3.4 | Processor |  |  |  |
|  | * Type |  |  |  |
|  | * Word length | Bits |  |  |
|  | * Clock speed (minimum) | GHz | 3 |  |
| 3.5 | Memory size | GB | 8 |  |
|  | * Supplied (minimum) | GB |  |  |
|  | * Supportable/expandable | GB |  |  |
| 3.6 | Hard disk size | TB | 8 |  |
|  | * Supplied (minimum) | GB |  |  |
|  | * Supportable/expandable | GB |  |  |
| 3.7 | Optical Storage | Yes/No | Yes |  |
| 3.8 | Pointer Device |  |  |  |
| 3.9 | Operating system |  |  |  |
| 3.10 | Operator interface screens |  |  |  |
| 3.11 | Operating temperature range | °C |  |  |
| 3.12 | Maximum relative humidity | % |  |  |
| 3.13 | Nominal voltage | Vac |  |  |
| 3.14 | Operating frequency | Hz |  |  |
| 3.15 | Starting current | A |  |  |
| 3.16 | Power requirement | W |  |  |
| 3.17 | Mean time between failure | Years | 15 |  |
| 3.18 | Mean time to repair | h | 96 |  |
| 3.19 | Operator Desk | Yes/No | Yes |  |
|  | * Manufacturer |  |  |  |
|  | * Type of construction (approval by KETRACO required) |  |  |  |
|  | * Finish and material of working surfaces |  |  |  |
|  | * Method of mounting VDUs |  |  |  |
|  | * Number |  |  |  |
| 3.20 | Operator Chairs (approx. 8 per station/Bay houses) | Yes/No | Yes |  |
|  | * Manufacturer |  |  |  |
|  | * Type of construction (approval by KETRACO required) |  |  |  |
|  | * Type of upholstery |  |  |  |
|  | * Number |  |  |  |
| **4.** | **Color Visual Display Units (MIN. 24 INCH VDUs)** |  |  |  |
| 4.1 | Manufacturer |  |  |  |
| 4.2 | Model |  |  |  |
| 4.3 | Literature reference for principle of operation | Yes/No | Yes |  |
| 4.4 | Screen size across diagonal (Minimum) | Inch | 24 |  |
| 4.5 | Usable display area | mm |  |  |
| 4.6 | Resolution (minimum) | pixels |  |  |
| 4.7 | Dot pitch | mm |  |  |
| 4.8 | Operating temperature range | °C |  |  |
| 4.9 | Operating relative humidity range | % |  |  |
| 4.10 | Nominal voltage | Vac |  |  |
| 4.11 | Operating frequency | Hz |  |  |
| 4.12 | Starting current | A |  |  |
| 4.13 | Power requirement | W |  |  |
| 4.14 | Approximate lifetime of monitor under continuous use | h |  |  |
| 4.15 | Mean time between failure | Years | 15 |  |
| 4.16 | Mean time to repair | h | 96 |  |
| **5** | **(LAN Substation Local Area Network)** |  |  |  |
| 5.1 | Architecture and Technology, Drawing and Description attached to the offer | Yes/No | Yes |  |
| 5.2 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 5.3 | Transmission medium (e.g. optical fibre) and physical specification |  |  |  |
| 5.4 | Protocols |  |  |  |
|  | * IEC 60870-5-101 | Yes/No | Yes |  |
|  | * IEC 60870-5-104 | Yes/No | Yes |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * List all other protocols |  |  |  |
| 5.5 | Data transmission rate(s) | Mbps |  |  |
| 5.6 | Physical arrangement - Identify all main elements in the supply including hubs, concentrators, bridges, routers, gateways switches etc. and the number of each |  |  |  |
| 5.7 | For each element of the LAN indicate the |  |  |  |
|  | * No and type of ports |  |  |  |
|  | * % of spare for each type of port | % | 20 |  |
| 5.8 | Management software package, functions and facilities, and hardware platform |  |  |  |
| 5.9 | % Loading under various system activity scenarios including |  |  |  |
|  | * normal loading for performance testing | % |  |  |
|  | * high loading for performance testing | % |  |  |
|  | * system power up | % |  |  |
|  | * main server fail-over and database resynchronisation | % |  |  |
| 5.10 | Overall availability | % |  |  |
| **6** | **Individual Elements** |  |  |  |
|  | For each element of the LAN equipment provide the following information |  |  |  |
| 6.1 | Manufacturer |  |  |  |
| 6.2 | Type |  |  |  |
| 6.3 | Nominal voltage |  |  |  |
| 6.4 | Power requirements | Vac |  |  |
| 6.5 | Range of ambient temp. and max relative humidity for continuous reliable operation | W |  |  |
| 6.6 | Mean time between failures | Years | 15 |  |
| 6.7 | Mean time to repair | h | 96 |  |
| **7** | **Logging/Event Printers** |  |  |  |
| 7.1 | Logging Printer | Yes/No | Yes |  |
| 7.2 | Manufacturer |  |  |  |
| 7.3 | Model |  |  |  |
| 7.4 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 7.5 | Number |  |  |  |
| 7.6 | Mounting arrangement |  |  |  |
| 7.7 | Method of printing (e.g. ink jet) |  |  |  |
| 7.8 | Print speed | ppm |  |  |
| 7.9 | Paper feed mechanism |  |  |  |
| 7.10 | Number of columns (minimum) |  |  |  |
| 7.11 | Operating temperature range | °C |  |  |
| 7.12 | Maximum relative humidity | % |  |  |
| 7.13 | Nominal voltage | Vac |  |  |
| 7.14 | Operating frequency | Hz |  |  |
| 7.15 | Power requirement | W |  |  |
| 7.16 | Max noise level at 1 m | dB(A) |  |  |
| 7.17 | Mean time between failure | Years | 15 |  |
| 7.18 | Mean time to repair | h | 96 |  |
| **8** | **Color Printers** |  |  |  |
| 8.1 | Manufacturer |  |  |  |
| 8.2 | Model |  |  |  |
| 8.3 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 8.4 | Number |  |  |  |
| 8.5 | Mounting arrangement |  |  |  |
| 8.6 | Print speed (minimum) | ppm |  |  |
| 8.7 | Technology |  |  |  |
| 8.8 | Resolution | dpi |  |  |
| 8.9 | Paper size |  |  |  |
| 8.10 | Sheet feed paper tray capacity | Sheets |  |  |
| 8.11 | Internal memory (minimum) | Mb |  |  |
| 8.12 | Operating temperature range | °C |  |  |
| 8.13 | Maximum relative humidity | % |  |  |
| 8.14 | Nominal voltage | Vac |  |  |
| 8.15 | Operating frequency | Hz |  |  |
| 8.16 | Power requirement | W |  |  |
| 8.17 | Max noise level at 1 m | dB(A) |  |  |
| 8.18 | Mean time between failure | Years | 15 |  |
| 8.19 | Mean time to repair | h | 96 |  |
| **9** | **Bay Control Unit Hardware** |  |  |  |
| 9.1 | General |  |  |  |
| 9.2 | Manufacturer |  |  |  |
| 9.3 | Module designation |  |  |  |
| 9.4 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.5 | Power supply | Vdc | 110 |  |
| 9.6 | Power Consumption | W |  |  |
| 9.7 | Maximum Number of expansion modules |  |  |  |
| 9.8 | Mean-time to repair for each type of BCU | Years | 15 |  |
| 9.9 | Mean-time between failure for each type of BCU | h | 96 |  |
| 9.10 | Local LCD Display | Yes/No | Yes |  |
| 9.11 | Operating temperature range | °C | 0 – 50 |  |
| 9.12 | Operating relative humidity range | % | 100 |  |
| 9.13 | BCUEnclosure |  |  |  |
|  | Manufacturer |  |  |  |
|  | Module designation |  |  |  |
|  | Literature reference for enclosure attached to the offer | Yes/No | Yes |  |
| 9.14 | Weight |  |  |  |
| 9.15 | Dimensions |  |  |  |
| 9.16 | Degree of protection |  |  |  |
| 9.17 | Flush mounted housing | Yes/No | Yes |  |
| 9.18 | Surface mounted housing | Yes/No |  |  |
| 9.2 | IEC Standards (or equivalent) |  |  |  |
| 9.3 | EMC Type tests (Provide Class/Level or Severity rating) | Yes/No | Yes |  |
| 9.4 | EMC Compliance IEC 60255-22-3 | Yes/No | Yes |  |
| 9.5 | Dielectric withstand test IEC 60255-4/-5 | Yes/No | Yes |  |
| 9.6 | High Voltage impulse test IEC 60255-4/-5 | Yes/No | Yes |  |
| 9.7 | Fast transient disturbance test IEC 61000-4-4 | Yes/No | Yes |  |
| 9.8 | Oscillatory transient IEC 61000-4-12 | Yes/No | Yes |  |
| 9.9 | Radiated immunity test IEC 61000-4-6 | Yes/No | Yes |  |
| 9.10 | Electrostatic discharge test IEC 61000-4-2 | Yes/No | Yes |  |
| 9.11 | Emitted interference test IEC 61000-4-3 | Yes/No | Yes |  |
| 9.12 | Mechanical test Compliance | Yes/No | Yes |  |
| 9.13 | Vibration test IEC 60255-21-1 | Yes/No | Yes |  |
| 9.14 | Shock test IEC 60255-21-2 | Yes/No | Yes |  |
| 9.15 | Seismic test IEC 60255-21-3 | Yes/No | Yes |  |
| 9.16 | Temperature rise test IEC 60068-2-2 | Yes/No | Yes |  |
| 9.17 | BCU Functions |  |  |  |
| 9.18 | The monitoring functions include: |  |  |  |
|  | * Switching status monitoring (breakers, disconnectors, earthing switches) | Yes/No | Yes |  |
|  | * Indication & alarm status monitoring | Yes/No | Yes |  |
|  | * Analogue measurements (curent, voltage, etc.) | Yes/No | Yes |  |
| 9.19 | Resolution of time tagging | ms | 1 |  |
| 9.20 | The control/protection functions include: |  |  |  |
|  | * Close / open of circuit breakers | Yes/No | Yes |  |
|  | * Close / Open of isolators / disconnectors | Yes/No | Yes |  |
|  | * Transformer automatic tap change control | Yes/No | Yes |  |
|  | * Breaker Voltage Synchronisation Check Control | Yes/No | Yes |  |
|  | * Bay interlocking facilities / with by-pass feature | Yes/No | Yes |  |
|  | * Breaker failure protection function (50BF) | Yes/No | Yes |  |
|  | * End fault protection function | Yes/No | Yes |  |
| 9.21 | The reporting functions include: |  |  |  |
|  | * Sequence of Events recording | Yes/No | Yes |  |
|  | * Post – Mortem Review / Fault waveform capture | Yes/No | Yes |  |
| 9.22 | Select and Confirm Before Operate functionality | Yes/No | Yes |  |
| 9.23 | Tenderers to state memory capacity and functionality of sequence of events |  |  |  |
| 9.24 | Tenderers to state memory capacity and functionality of fault waveform capture |  |  |  |
| 9.25 | BCU Configuration |  |  |  |
| 9.26 | Number of processors |  |  |  |
| 9.27 | Main processor |  |  |  |
| 9.28 | Secondary processors |  |  |  |
| 9.29 | Communication processor (module) |  |  |  |
| 9.30 | Type of communication between processors |  |  |  |
| 9.31 | LCD display and selector buttons on front of BCU, functionality to include: | Yes/No | Yes |  |
|  | * Full control of circuit bay | Yes/No | Yes |  |
|  | * Status of bay plant | Yes/No | Yes |  |
|  | * Circuit active line diagram | Yes/No | Yes |  |
|  | * Power system measurements | Yes/No | Yes |  |
|  | * Display alarms and events | Yes/No | Yes |  |
| 9.32 | Processing Units |  |  |  |
| 9.33 | Main CPU |  |  |  |
| 9.34 | Manufacturer |  |  |  |
| 9.35 | Module designation |  |  |  |
| 9.36 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.37 | Mean time between failure | Years | 15 |  |
| 9.38 | Power requirements | W |  |  |
| 9.39 | Type of processor |  |  |  |
| 9.40 | Word length | bit |  |  |
| 9.41 | Clock speed | MHz |  |  |
| 9.42 | Kinds of memory used: |  |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
| 9.43 | Secondary CPU |  |  |  |
| 9.44 | Manufacturer |  |  |  |
| 9.45 | Module designation |  |  |  |
| 9.45 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.46 | Mean time between failure | Years | 15 |  |
| 9.47 | Power requirements | W |  |  |
| 9.48 | Type of processor |  |  |  |
| 9.49 | Word length | bit |  |  |
| 9.50 | Clock speed | MHz |  |  |
| 9.51 | Kinds of memory used: |  |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
|  | * Type, size and extension capabilities | Kbytes |  |  |
| 9.52 | Communications |  |  |  |
| 9.53 | Manufacturer |  |  |  |
| 9.54 | Module designation |  |  |  |
| 9.55 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.56 | Number of communications channels |  |  |  |
| 9.57 | Type of processor |  |  |  |
| 9.58 | Word length |  |  |  |
| 9.59 | Clock speed | bit |  |  |
| 9.60 | Type and size of memory | MHz |  |  |
| 9.61 | Line interface to communication channel |  |  |  |
| 9.62 | Speed of transmission | B/s |  |  |
| 9.63 | Number and type of communication ports |  |  |  |
| 9.64 | Meantime between failure | Years | 15 |  |
| 9.65 | Power requirement | W |  |  |
| 9.66 | Communication Interfaces |  |  |  |
|  | * IEC60870-5-101 direct to Control Centre(s) | Yes/No |  |  |
|  | * IEC60870-5-103 interface to protection IED | Yes/No |  |  |
|  | * IEC61850 interface to substation LAN | Yes/No | Yes |  |
|  | * IEC60870-5-101 for remote downloading of BCU data | Yes/No |  |  |
|  | * List all Protocols available at BCU |  |  |  |
| 9.67 | Local interface for Laptop Computer | Yes/No | Yes |  |
| 9.68 | IED Interface |  |  |  |
|  | * List of manufactures the BCU has interfaced attached to the offer | Yes/No | Yes |  |
|  | * Standard communication protocols available, list attached to the offer | Yes/No | Yes |  |
|  | * Optional communication protocols available, list attached to the offer | Yes/No | Yes |  |
| 9.69 | Power Supply Module |  |  |  |
| 9.70 | Module designation |  |  |  |
| 9.71 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.72 | Maximum number of modules per processor |  |  |  |
| 9.73 | Nominal Input voltage | V dc | 110 |  |
| 9.74 | Operating voltage range |  |  |  |
| 9.75 | Power requirement | W |  |  |
| 9.76 | Insulation | kV |  |  |
| 9.77 | Meantime between failure | Years | 15 |  |
| 9.78 | Power requirement | W |  |  |
| 9.79 | Digital Input Module |  |  |  |
| 9.80 | Module designation |  |  |  |
| 9.81 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.82 | Maximum number of modules per processor |  |  |  |
| 9.83 | Input voltage | Vdc | 110 |  |
| 9.84 | Is contact input type configurable as |  |  |  |
|  | * Status and alarms | Yes/No | Yes |  |
|  | * Sequence of events | Yes/No | Yes |  |
|  | * BCD or parallel inputs | Yes/No | Yes |  |
|  | * Pulse accumulator | Yes/No | Yes |  |
|  | * Or any combination of these | Yes/No | Yes |  |
| 9.85 | Standard number of inputs per module: |  |  |  |
|  | * double position |  |  |  |
|  | * single position |  |  |  |
| 9.86 | Type of input circuit isolation |  |  |  |
| 9.87 | Input galvanic separation |  |  |  |
| 9.88 | Impulse voltage withstands | kV |  |  |
| 9.89 | Scan time | ms |  |  |
| 9.90 | Minimal pulse duration | ms |  |  |
| 9.91 | Input impedance | ohm |  |  |
| 9.92 | Filter time constant | ms |  |  |
| 9.93 | Meantime between failure | Years | 15 |  |
| 9.94 | Power requirement | W |  |  |
| 9.95 | Pulse Counting Module |  |  |  |
| 9.96 | Is this facility incorporated into the digital input module? | Yes/No | Yes |  |
| 9.97 | Module designation |  |  |  |
| 9.98 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.99 | Maximum number of modules per processor |  |  |  |
| 9.100 | Type of counter |  |  |  |
| 9.101 | Maximum count |  |  |  |
| 9.102 | Storage and resetting under control of external clock? | Yes/No | Yes |  |
| 9.103 | Number of inputs per module |  |  |  |
| 9.104 | Input current | mA |  |  |
| 9.105 | Impulse voltage withstands | kV |  |  |
| 9.106 | Signal range: pulse widths | ms |  |  |
| 9.107 | Meantime between failure | Years | 15 |  |
| 9.108 | Power requirement | W |  |  |
| 9.109 | Command Output Module |  |  |  |
| 9.110 | Module designation |  |  |  |
| 9.111 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.112 | Maximum number of modules per processor |  |  |  |
| 9.113 | Contact ratings |  |  |  |
|  | * Switched voltage | V |  |  |
|  | * Switched power | VA max |  |  |
|  | * Switched current | A |  |  |
|  | * Range of duration of command output | s |  |  |
| 9.114 | Number of two position output channels per module |  |  |  |
| 9.115 | Are outputs activated by select-check-actuate procedure? | Yes/No |  |  |
| 9.116 | Are welded contacts checked prior to command output? | Yes/No |  |  |
| 9.117 | Are the outputs fused and fuse status monitored? | Yes/No |  |  |
| 9.118 | Impulse voltage withstands | kV |  |  |
| 9.119 | Meantime between failure | Years | 15 |  |
| 9.120 | Power requirement | W |  |  |
| 9.121 | Digital Output Module |  |  |  |
| 9.122 | Module designation |  |  |  |
| 9.123 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.124 | Number of outputs per module |  |  |  |
| 9.125 | Maximum number of modules per processor |  |  |  |
| 9.126 | Maximum output current | mA |  |  |
| 9.127 | Maximum switched output voltage | V |  |  |
| 9.128 | Impulse voltage withstand | kV |  |  |
| 9.129 | Type of protection against back EMF | kV |  |  |
| 9.130 | Command duration adjustable in the range | s |  |  |
| 9.131 | Meantime between failure | Years | 15 |  |
| 9.132 | Power requirement | W |  |  |
| 9.133 | Analogue to digital conversion module |  |  |  |
| 9.134 | Module designation |  |  |  |
| 9.135 | Literature reference for principle of operation |  |  |  |
| 9.136 | Number of inputs per module |  |  |  |
| 9.137 | Maximum number of modules per processor |  |  |  |
| 9.138 | Resolution | bits |  |  |
| 9.139 | Accuracy | % |  |  |
| 9.140 | Common mode noise rejection | dB |  |  |
| 9.141 | Normal mode noise rejection | dB |  |  |
| 9.142 | Conversion time | ms |  |  |
| 9.143 | Scanning time (per channel) | ms |  |  |
| 9.144 | Meantime between failures | Years | 15 |  |
| 9.145 | Power requirement | W |  |  |
| 9.146 | Analogue Input Module |  |  |  |
| 9.147 | Module designation |  |  |  |
| 9.148 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.149 | Maximum number of modules per processor |  |  |  |
| 9.150 | Scanning resolution | bits |  |  |
| 9.151 | Accuracy | % |  |  |
| 9.152 | How are overflow and conversion failures dealt with? |  |  |  |
| 9.153 | Conversion time |  |  |  |
| 9.154 | Input filter attenuation at 50 Hz | dB |  |  |
| 9.155 | Input signal types (e.g. 4-20 mA) |  |  |  |
| 9.156 | Method of isolation |  |  |  |
| 9.157 | Impulse voltage withstand | kV |  |  |
| 9.158 | Input impedance | ohm |  |  |
| 9.159 | Type of ADC switching |  |  |  |
| 9.160 | Standard number of inputs per module |  |  |  |
| 9.161 | Mean time between failure | Years | 15 |  |
| 9.162 | Power requirement | W |  |  |
| 9.163 | Analogue Output Module |  |  |  |
| 13.9.164 | Module designation |  |  |  |
| 9.165 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.166 | Number of outputs per module |  |  |  |
| 9.167 | Maximum number of modules per processor |  |  |  |
| 9.168 | Output voltage range | V |  |  |
| 9.169 | Output current range | mA |  |  |
| 9.170 | Type of isolation |  |  |  |
| 9.171 | Load resistance range | ohms |  |  |
| 9.172 | Maximum error over-current ranges | % |  |  |
| 9.173 | Impulse voltage withstands | kV |  |  |
| 9.174 | Direct AC Connection Voltage |  |  |  |
| 13.9.175 | Module designation |  |  |  |
| 9.176 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.177 | Maximum number of modules processor |  |  |  |
| 9.178 | Number of inputs per module |  |  |  |
| 9.179 | Input voltage ranges | Vac |  |  |
| 9.180 | Input filter attenuation at 50 Hz | dB |  |  |
| 9.181 | Burden on instrument transformer circuit | VA |  |  |
| 9.182 | Conversion time | ms |  |  |
| 9.183 | Scanning resolution | bits |  |  |
| 9.184 | Accuracy | % |  |  |
| 9.185 | What calculations are supported? |  |  |  |
| 9.186 | How are overflow and conversion failures dealt with? |  |  |  |
| 9.187 | Method of isolation |  |  |  |
| 9.188 | Impulse voltage withstands kV | kV |  |  |
| 9.189 | Direct AC Connection Current |  |  |  |
| 9.190 | Module designation |  |  |  |
| 9.191 | Literature reference for principle of operation attached to the offer | Yes/No | Yes |  |
| 9.192 | Maximum number of modules processor |  |  |  |
| 9.193 | Number of inputs per module |  |  |  |
| 9.194 | Input current ranges | A |  |  |
| 9.195 | Input filter attenuation at 50 Hz | dB |  |  |
| 9.196 | Burden on instrument transformer circuit | VA |  |  |
| 9.197 | Conversion time | ms |  |  |
| 9.198 | Scanning resolution | bits |  |  |
| 9.199 | Accuracy | % |  |  |
| 9.200 | What calculations are supported? |  |  |  |
| 9.201 | How are overflow and conversion failures dealt with? |  |  |  |
| 9.202 | Method of isolation |  |  |  |
| 9.203 | Impulse voltage withstand kV | kV |  |  |
| **10** | **BCU software** |  |  |  |
| 10.1 | General requirements |  |  |  |
| 10.2 | Program structure |  |  |  |
| 10.3 | System software |  |  |  |
| 10.4 | Standard functions programs |  |  |  |
| 10.5 | User functions programs |  |  |  |
| 10.6 | Capability of: |  |  |  |
|  | BCU program downloading from Control Centre | Yes/No |  |  |
|  | Application configuration from Control Centre | Yes/No |  |  |
|  | Remote selection of processing parameters | Yes/No |  |  |
|  | Selection of communication protocols | Yes/No |  |  |
|  | Selection of operation modes (cyclic, polled, etc.) | Yes/No |  |  |
|  | Appropriate protection of software against power failure | Yes/No |  |  |
|  | Automatic BCU re-start without software down-loading | Yes/No |  |  |
| 10.7 | System software |  |  |  |
| 10.8 | Operating system (monitor) functions and capabilities |  |  |  |
| 10.9 | Calendar program type, functions and capabilities |  |  |  |
| 10.10 | Time Synchronization Program Functions and capabilities |  |  |  |
| 10.11 | Data Base Updating program functions and capabilities |  |  |  |
| 10.12 | Testing and Diagnostics Programs Functions and capabilities | Yes/No | Yes |  |
| 10.13 | Standard functions program |  |  |  |
| 10.14 | Data Communication Programs: Functions and capabilities |  |  |  |
| 10.15 | Capability of communication protocol selection |  |  |  |
| 10.16 | Capability of operating modes selection |  |  |  |
| 10.17 | Analogue measurements, scanning and transmission programs |  |  |  |
| 10.18 | Capabilities of adjustments |  |  |  |
| 10.19 | Transducers constants |  |  |  |
| 10.20 | Periodic transmission/transmission by exception |  |  |  |
| 10.21 | Automatic checking of A/D-conversion accuracy |  |  |  |
| 10.22 | Smoothing |  |  |  |
| 10.23 | Threshold values |  |  |  |
| 10.24 | Limits |  |  |  |
| 10.25 | Scan duration (range) | ms |  |  |
| 10.26 | Cycle duration (range) | ms |  |  |
| 10.27 | Priority of transmission |  |  |  |
| 10.28 | Digital Input Data Scanning and transmission Program |  |  |  |
| 10.29 | Functions and capabilities |  |  |  |
| 10.30 | Capability of adjustments; |  |  |  |
| 10.31 | Scan duration (range) | ms |  |  |
| 10.32 | Transient time of status information (range) | ms |  |  |
| 10.33 | Cycle duration (range) | ms |  |  |
| 10.34 | De-bouncing filter | s |  |  |
| 1035 | Suppression of intermediate status information |  |  |  |
| 10.36 | Time tagging |  |  |  |
| 10.37 | Transmission mode |  |  |  |
| 10.38 | Priority of transmission |  |  |  |
| 10.39 | Alarm and Event handling |  |  |  |
| 10.40 | Grouping of alarms and events |  |  |  |
| 10.41 | Maximum number of groups |  |  |  |
| 10.42 | Supervisory control programs: Functions and capabilities |  |  |  |
| 10.43 | Select before execute |  |  |  |
| 10.44 | Target check |  |  |  |
| 10.45 | Cancelling control after adjustable time delay |  |  |  |
| 10.46 | Capability of adjustments: |  |  |  |
| 10.47 | Duration of output (range) | s |  |  |
| 10.48 | Allowed duration of execution (range) | s |  |  |
| 10.49 | Sequence of Events programs |  |  |  |
| 10.50 | Minimal sequence of events time resolution | ms |  |  |
| 10.51 | Sequence of events memory capacity |  |  |  |
| 10.52 | Events time resolution (adjustable range) |  |  |  |
| 10.53 | Priority of transmission |  |  |  |
| 10.54 | Post - Mortem Review / Program |  |  |  |
| 10.55 | Selection of analogues for post-mortem review |  |  |  |
| 10.56 | Short interval time resolution (adjustable range) | s |  |  |
| 10.57 | Long interval time resolution (adjustable range) | s |  |  |
| 10.58 | Data processing programs: Functions and capabilities |  |  |  |
| 10.59 | Required minimum data processing: |  |  |  |
| 10.60 | Logic functions |  |  |  |
| 10.61 | Arithmetical functions (MW, MVAr, etc ) |  |  |  |
| 10.62 | Limiting functions | s |  |  |
| 10.63 | Comparative functions |  |  |  |
| 10.64 | Time functions |  |  |  |
| **11** | **Gateway Software** |  |  |  |
| 11.1 | General requirements |  |  |  |
| 11.2 | Database management application |  |  |  |
| 11.3 | Alarm and Event Grouping |  |  |  |
| 11.4 | Alarm and Event Separation for NCC and RCC |  |  |  |
| 11.5 | Alarm and event storage and remote / local access |  |  |  |
| 11.6 | Capability of: |  |  |  |
|  | Gateway program downloading from Control Centre |  |  |  |
|  | Application configuration from Control Centre |  |  |  |
|  | Remote selection of processing parameters |  |  |  |
|  | Selection of communication protocols |  |  |  |
|  | Selection of operation modes (cyclic, polled, etc.) |  |  |  |
|  | Appropriate protection of software against power failure |  |  |  |
|  | Automatic re-start without software down-loading |  |  |  |
| **12** | **System software** |  |  |  |
| 12.1 | Operating System (Monitor) Functions and capabilities |  |  |  |
| 12.2 | Calendar program Type, functions and capabilities |  |  |  |
| 12.3 | Time Synchronization Program Functions and capabilities |  |  |  |
| 12.4 | Data Base Updating program Functions and capabilities |  |  |  |
| 12.5 | Testing and Diagnostics Programs Functions and capabilities |  |  |  |
| **13** | **Transducers** |  |  |  |
| 13.1 | Current transducer |  |  |  |
| 13.2 | Manufacturer |  |  |  |
| 13. 3 | Type reference |  |  |  |
| 13. 4 | Number |  |  |  |
| 13. 5 | Principle (e.g. 3 phase, 3 wire, unbalanced) |  |  |  |
| 13. 6 | Output range | mA |  |  |
| 13. 7 | Input ranges available | A |  |  |
| 13. 8 | Burden on instrument transformer circuit | VA |  |  |
| 13.9 | Insulation level | kV |  |  |
| 13.10 | Impulse withstand level | kV peak |  |  |
| 13.11 | Minimum accuracy over working range | % |  |  |
| 13.9.7.12 | Response time (0 to 90%) | ms |  |  |
| 13.13 | Mounting details |  |  |  |
| 13.14 | Operating temperature range | °C |  |  |
| 13. 15 | Operating humidity range | % |  |  |
| 13.16 | Auxiliary supply if required |  |  |  |
| 13. 17 | Voltage range | V |  |  |
| 13. 18 | Power requirements | VA |  |  |
| 13. 19 | Frequency | Hz |  |  |
| 13. 20 | Type of overload protection |  |  |  |
| 13. 21 | Permissible continuous input overload | %A |  |  |
| 13. 22 | Voltage transducer |  |  |  |
| 13. 23 | Manufacturer |  |  |  |
| 13. 24 | Type |  |  |  |
| 13. 25 | Number |  |  |  |
| 13. 26 | Output range | mA |  |  |
| 13. 27 | Input ranges available | V |  |  |
| 13. 28 | Burden on instrument transformer circuit | VA |  |  |
| 13. 29 | Insulation level | kV |  |  |
| 13..30 | Impulse withstand level | kV peak |  |  |
| 13.31 | Minimum accuracy over working range | % |  |  |
| 13. 32 | Response time (0 to 90%) | ms |  |  |
| 13..33 | Mounting details |  |  |  |
| 13. 34 | Operating temperature range | °C |  |  |
| 13. 35 | Operating humidity range | % |  |  |
| 13.35 | Auxiliary supply |  |  |  |
| 13. 36 | V range | V |  |  |
| 13. 37 | Power requirements | VA |  |  |
| 13. 38 | Frequency | Hz |  |  |
| 13. 38 | Type of overload protection |  |  |  |
| 13..39 | Permissible continuous input overload | %A |  |  |
| **14.** | **Active Power MW** |  |  |  |
| 14.1 | Manufacturer |  |  |  |
| 14.2 | Type reference |  |  |  |
| 14.3 | Number |  |  |  |
| 14.4 | Principle (e.g. 3 phase, 3 wire, unbalanced) |  |  |  |
| 14.5 | Output range | mA |  |  |
| 14.6 | Input ranges available |  |  |  |
| 14.7 | Voltage | V |  |  |
| 14.8 | Current | A |  |  |
| 14.9 | Burden on instrument transformer circuit |  |  |  |
| 14.10 | Current Transformer (CT) | VA |  |  |
| 14.11 | Voltage Transformer (VT) | VA |  |  |
| 14.12 | Insulation level | kV |  |  |
| 14.13 | Impulse withstand level | kV peak |  |  |
| 14.14 | Minimum accuracy over working range | % |  |  |
| 14.15 | Response time (0 to 90%) | ms |  |  |
| 14.16 | Mounting details |  |  |  |
| 14.17 | Operating temperature range | °C |  |  |
| 14.18 | Operating humidity range | % |  |  |
| 14.19 | Auxiliary supply if required |  |  |  |
| 14.20 | Voltage range | V |  |  |
| 14.21 | Power requirements | VA |  |  |
| 14.22 | Frequency | Hz |  |  |
| 14.23 | Type of overload protection |  |  |  |
| 14.24 | Permissible continuous input overload |  |  |  |
| 14.25 | Voltage | %V |  |  |
| 14.26 | Current | %A |  |  |
| **15.** | **Reactive Power MVAR’s** |  |  |  |
| 15.01 | Manufacturer |  |  |  |
| 15.02 | Type reference |  |  |  |
| 15.03 | Number |  |  |  |
| 15.04 | Principle (e.g. 3 phase, 3 wire, unbalanced) |  |  |  |
| 15.05 | Output range | mA |  |  |
| 15.06 | Input ranges available |  |  |  |
| 15.07 | Voltage | V |  |  |
| 15.08 | Current | A |  |  |
| 15.09 | Burden on instrument transformer circuit |  |  |  |
| 15.10 | Current Transformer (CT) | VA |  |  |
| 15.11 | Voltage Transformer (VT) | VA |  |  |
| 15.12 | Insulation level | kV |  |  |
| 15.13 | Impulse withstand level | kVpeak |  |  |
| 15.14 | Minimum accuracy over working range | % |  |  |
| 15.15 | Response time (0 to 90%) | ms |  |  |
| 15.16 | Mounting details |  |  |  |
| 15.17 | Operating temperature range | °C |  |  |
| 15.18 | Operating humidity range | % |  |  |
| 15.19 | Auxiliary supply |  |  |  |
| 15.20 | Voltage range | V |  |  |
| 15.21 | Power requirements | VA |  |  |
| 15.22 | Frequency | Hz |  |  |
| 15.23 | Type of overload protection |  |  |  |
| 15.24 | Permissible continuous input overload |  |  |  |
| 15.25 | Voltage | %V |  |  |
| 15.26 | Current | %A |  |  |
| **16.** | **Frequency** |  |  |  |
| 16.1 | Manufacturer |  |  |  |
| 16.2 | Type |  |  |  |
| 16.3 | Number |  |  |  |
| 16.4 | Measurement range | Hz |  |  |
| 16.5 | Output range | mA |  |  |
| 16.6 | Input ranges available | Vac |  |  |
| 16.7 | Burden on instrument VT circuit | VA |  |  |
| 16.8 | Insulation level | kV |  |  |
| 16.9 | Impulse withstand level | kV peak |  |  |
| 16.10 | Minimum accuracy over working range | % |  |  |
| 16.11 | Response time (0 to 90%) | ms |  |  |
| 16.12 | Mounting details |  |  |  |
| 16.13 | Operating temperature range | °C |  |  |
| 16`.14 | Auxiliary supply |  |  |  |
| 16.15 | Voltage range | V |  |  |
| 16.16 | Power requirements | VA |  |  |
| 16.17 | Frequency | Hz |  |  |
| 16.18 | Type of overload protection |  |  |  |
| 16.19 | Permissible continuous input overload %V | % |  |  |
| **16.** | **Power Factor** |  |  |  |
| 16.1 | Manufacturer |  |  |  |
| 16.2 | Type |  |  |  |
| 16.3 | Number |  |  |  |
| 16.4 | Measurement range |  |  |  |
| 16.5 | Output range | mA |  |  |
| 16.6 | Input ranges available | V ac |  |  |
| 16.7 | Burden on instrument VT circuit | VA |  |  |
| 16.8 | Insulation level | kV |  |  |
| 16.9 | Impulse withstand level | kV peak |  |  |
| 16.10 | Minimum accuracy over working range | % |  |  |
| 16.11 | Response time (0 to 90%) | ms |  |  |
| 16.12 | Mounting details |  |  |  |
| 16.13 | Operating temperature range | °C |  |  |
| 16.14 | Auxiliary supply |  |  |  |
| 16.15 | Voltage range | V |  |  |
| 16.16 | Power requirements | VA |  |  |
| 16.17 | Frequency | Hz |  |  |
| 16.18 | Type of overload protection |  |  |  |
| 16.19 | Permissible continuous input overload | % |  |  |
| **17** | **Combined active and reactive power** |  |  |  |
| 17.1 | Manufacturer |  |  |  |
| 17.2 | Type |  |  |  |
| 17.3 | Number |  |  |  |
| 17.4 | Measurement range |  |  |  |
| 17.5 | Input ranges available |  |  |  |
| 17.6 | Voltage | Vac |  |  |
| 17.7 | Current | A |  |  |
| 17.8 | Burden on instrument transformer circuit |  |  |  |
| 17..9 | Current Transformer (CT) | VA |  |  |
| 17.10 | Voltage Transformer (VT) | VA |  |  |
| 17`11 | Insulation level | kV |  |  |
| 17.12 | Impulse withstand level | kV peak |  |  |
| 17.13 | Minimum accuracy over working range | % |  |  |
| 17.14 | Response time (0 to 90%) | ms |  |  |
| 17.15 | Number of analogue outputs |  |  |  |
| 17.16 | Analogue output range | mA |  |  |
| 17.17 | Calculations available |  |  |  |
| 17.18 | Serial output protocol |  |  |  |
| 17.19 | Mounting details |  |  |  |
| 17.20 | Operating temperature range | °C |  |  |
| 17.21 | Auxiliary supply |  |  |  |
| 17.22 | Voltage range | V |  |  |
| 17.23 | Power requirements | VA |  |  |
| 17.24 | Frequency | Hz |  |  |
| 17.25 | Type of overload protection |  |  |  |
| 17.26 | Permissible continuous input overload |  |  |  |
| 17.27 | Voltage | %V |  |  |
| 17.28 | Current | %A |  |  |

# TELECOMMUNICATION SYSTEM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| **1** | **SDH** |  |  |  |
| 1.1 | Manufacturer's name |  |  |  |
| 1.2 | Product Trade Name |  |  |  |
| 1.3 | Type of Model /Version Number |  |  |  |
| 1.4 | Production Number |  |  |  |
| 1.5 | FAT Location |  |  |  |
| 1.6 | Applicable Standard(s) |  | ITU-T,IEEE,IEC |  |
| 1.7 | Platform |  | To be defined |  |
| 1.8 | Type tests reports and certification docs |  | Required |  |
| 1.9 | Availability (based on MTBF) |  | To be defined |  |
| 1.10 | Flexibility |  | Required |  |
| 1.11 | Expandability |  | Required |  |
| 1.12 | Automatic Laser Shutdown (ALS) |  | G.664 Appendix III.2 |  |
| 1.13 | Rack & Shelf Information |  |  |  |
| 1.13.1 | 19" or ETSI rack mounting (44U) |  | Required |  |
| 1.13.2 | Sub rack Dimension | mm | To be defined |  |
| 1.13.3 | Rack Dimension | mm | To be defined |  |
| 1.13.4 | Sub rack Weight (fully populated) | kg | To be defined |  |
| 1.13.5 | Power Consumption (fully populated) | watt | To be defined |  |
| 1.13.6 | Power Supply | VDC | (-48 VDC) |  |
| 1.13.7 | Numbers of Slots (Total & Traffic) |  | To be defined |  |
| 1.13.8 | Numbers of Traffic Slots |  | To be defined |  |
| 1.13.9 | Traffic Slot Capacity (Full duplex) |  | To be defined |  |
| 1.14 | Environment Condition |  |  |  |
| 1.14.1 | Transport |  |  |  |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1.14.1.1 | Max. Transport Temperature | ºC | (+ 60) |  |
| 1.14.1.2 | Min. Transport Temperature | ºC | (- 20) |  |
| 1.14.1.3 | Humidity |  | (0% to 90%) |  |
| 1.14.2 | Storage |  |  |  |
| 1.14.2.1 | Max. Transport Temperature | ºC | (+ 60) |  |
| 1.14.2.2 | Min. Transport Temperature | ºC | (- 10) |  |
| 1.14.2.3 | Humidity (0% to 90%) | % | (0% to 90%) |  |
| 1.14.3 | Operation |  |  |  |
| 1.14.3.1 | Max. Transport Temperature | ºC | (+ 55) |  |
| 1.14.3.2 | Min. Transport Temperature | ºC | (- 5) |  |
| 1.14.3.3 | Humidity | % | (0% to 90%) |  |
| 1.15 | Certifications (MANDATORY) |  |  |  |
| 1.15.1 | EMC |  | Required |  |
| 1.15.2 | EMI |  | Required |  |
| 1.15.5 | Reference List only for Proposed systems |  | Required |  |
| 1.16 | Redundancy |  |  |  |
| 1.16.1 | CPU |  | (1+1) |  |
| 1.16.2 | CXC (Cross connection) |  | (1+1) |  |
| 1.16.3 | Power supply |  | (1+1) |  |
| 1.16.4 | 2M Electrical port (E1) |  | 1:N (N shall be specified) |  |
| 1.16.5 | clock card |  | shall be specified |  |
| 1.16.6 | Protection for STM16 (G.841 - clause 7.1) |  | 1+1 Linear MSP(G.841 - clause 7.1) |  |
| 1.17 | Network Side Protection |  |  |  |
| 1.17.1 | 1+1 Linear MSP |  | Required |  |
| 1.17.2 | SNCP |  | Required |  |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1.18 | Switch Capacity Centralized architecture |  |  |  |
| 1.18.1 | TDM- STM 16 system | Gigab/s | Min 20 |  |
| 1.18.2 | TDM- STM 1 system | Gigab/s | Min 10 |  |
| 1.18.3 | Packet |  | Advantage |  |
| 1.19 | Ethernet interfaces |  |  |  |
| 1.19.1 | 10/100 Base-TX L2 switching Ethernet port |  | Required |  |
| 1.19.2 | Auto-negotiation |  | Required |  |
| 1.19.3 | Auto-crossover |  | Required |  |
| 1.19.4 | Unique MAC address to each Ethernet port |  | Required |  |
| 1.20 | Ethernet services |  |  |  |
| 1.20.1 | E-Line |  | Required |  |
| 1.20.2 | E-LAN |  | Required |  |
| 1.21 | Ethernet protection |  |  |  |
| 1.21.1 | Spanning Tree Protocol |  | Required |  |
| 1.21.2 | Rapid Spanning Tree Protocol |  | Required |  |
| 1.22 | NG-SDH Management LCT Functionalities |  |  |  |
| 1.22.1 | local and remote management of NE's over the network |  | Required |  |
| 1.22.2 | Alarm display |  | Required |  |
| 1.22.3 | Fault Management |  | Required |  |
| 1.22.4 | Performance Monitoring and Management |  | Required |  |
| 1.22.5 | Configuration Management |  | Required |  |
| 1.22.6 | Remote operation |  | Required |  |
| 1.22.7 | Access and testing functions |  | Required |  |
| 1.22.8 | Graphical view of entire network |  | Required |  |
| 1.22.9 | Local Craft terminal Port |  | Required |  |
| 1.23 | LCT Hardware (Laptop specification) |  |  |  |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1.23.1 | Type & CPU | G | CPU: Core I7 |  |
| 1.23.2 | HHD Capacity | G | >500 |  |
| 1.23.3 | RAM |  | 6 |  |
| 1.23.4 | LCD size (inch) |  | Less than 15 |  |
| **2** | **Access Mux** |  |  |  |
| 2.1 | GENERAL |  |  |  |
| 2.1.1 | Manufacturer name |  |  |  |
| 2.1.2 | Product trade name |  |  |  |
| 2.1.3 | Type of Model/Version Number |  |  |  |
| 2.1.4 | FAT location |  |  |  |
| 2.1.5 | Applicable Standard(s) |  | ITU-T |  |
| 2.1.6 | Type tests reports and certification documents |  | To be defined |  |
| 2.1.7 | Availability (based on MTBF) |  | To be defined |  |
| 2.1.8 | Flexibility |  | Required |  |
| 2.1.9 | Expandability |  | Required |  |
| 2.2 | Rack and shelf information |  |  |  |
| 2.2.1 | 19" or ETSI rack mounting |  | To be defined |  |
| 2.2.2 | Shelf Dimension (height x width x length) | mm | To be defined |  |
| 2.2.3 | Shelf Weight(fully populated) | kg | To be defined |  |
| 2.2.4 | Power Consumption(fully populated) | watt | To be defined |  |
| 2.2.5 | Power Supply | V Dc | To be defined |  |
| 2.2.6 | Numbers of Slots (Total & Traffic) |  | To be defined |  |
| 2.2.7 | Numbers of Traffic Slots |  | To be defined |  |
| 2.3 | General Functionality |  |  |  |
| 2.3.1 | Time multiplexing/ de-multiplexing  of all voice and data channels |  | Required |  |
| 2.3.2 | Sub rate data multiplexing based on  ITU-T V-Series synch/a synch data |  | Required |  |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 2.3.3 | Cross-Connecting |  | at n×64 Kbps, 64 Kbps,  Time Slot and Bit levels |  |
| 2.3.4 | Cross-connect capacity |  | To be defined |  |
| 2.3.5 | Drop/Insert |  | Required |  |
| 2.3.6 | IP routing |  | Optional |  |
| 2.3.7 | VF operation |  | Required |  |
| 2.3.8 | Signaling |  | To be defined |  |
| 2.3.9 | Transmission delay | µs | <250 |  |
| 2.4 | Line Interface |  |  |  |
| 2.4.1 | E1 |  | Required |  |
| 2.4.2 | STM1 |  | Advantage |  |
| 2.5 | Interfaces |  |  |  |
| 2.5.1 | 6 wire E&M signaling with ring generator |  | Required |  |
| 2.5.2 | 2 wire voice channel |  | Required |  |
| 2.5.3 | FXO/FXS |  | Required |  |
| 2.5.4 | 0.3-64 Kbps Sync. /A sync. V.24/V.28 |  | Required |  |
| 2.5.5 | N × 64 Kbps Sync. /A sync. |  | Required |  |
| 2.5.6 | RS-232, RS-485 |  | Required |  |
| 2.5.7 | Ethernet |  | Required |  |
| 2.6 | Redundancy |  |  |  |
| 2.6.1 | Line card redundancy |  | 1+1 |  |
| 2.6.2 | Power Supply redundancy |  | 1+1 |  |
| 2.6.3 | Cross Connection redundancy |  | 1+1 |  |
| 2.6.4 | Redundancy of Processor |  | 1+1 |  |
| 2.6.5 | Clock |  | To be defined |  |
| 2.6.6 | Cooling fans redundancy |  | To be defined |  |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 2.7 | Environmental condition |  |  |  |
| 2.7.1 | Operating Temperature (Long/Short term) |  | To be defined |  |
| 2.7.2 | Storage & Transportation temperature |  | To be defined |  |
| 2.7.3 | Humidity (St., Tr., Op.) (%) |  | To be defined |  |
| 2.8 | Configurations |  |  |  |
| 2.8.1 | Terminal with Multiplexing & Sub multiplexing |  | Required |  |
| 2.8.2 | ADM in Linear & Ring |  | Required |  |
| 2.8.3 | CXC in Mesh & Tree |  | Advantage |  |
| 2.9 | Access MUX Management LCT Functionalities |  |  |  |
| 2.9.1 | local and remote management of NE's over the network |  | Required |  |
| 2.9.2 | Alarm display |  | Required |  |
| 2.9.3 | Fault Management |  | Required |  |
| 2.9.4 | Performance Monitoring and Management |  | Required |  |
| 2.9.5 | Configuration Management |  | Required |  |
| 2.9.6 | Remote operation |  | Required |  |
| 2.9.7 | Access and testing functions |  | Required |  |
| 2.9.8 | Graphical view of entire network |  | Required |  |

# LV SERVICES EQUIPMENT

## LVAC SWITCHGEAR (415/240 V, 50 HZ)

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| **1** | **GENERAL** |  |  |  |
|  | Network configuration |  | TN-S |  |
|  | Rated operating voltage | V | 415 |  |
|  | Rated frequency | Hz | 50 |  |
| **2** | **LVAC SWITCHBOARD** |  |  |  |
| 2.1 | Manufacturer |  |  |  |
| 2.2 | Type designation |  |  |  |
| 2.3 | Type of switchboard |  |  |  |
| 2.4 | Standards |  | IEC 61439 |  |
| 2.5 | Number of years’ equipment of identical design has been in service |  |  |  |
| 2.6 | Rated current of bus bars at 40°C ambient temperature | A | 1000 |  |
| 2.7 | Bus bar cross section | mm2 |  |  |
| 14.1.2.8 | Bus bar insulation material |  |  |  |
| 2.9 | Bus bar insulation maximum working temperature | °C |  |  |
| 2.10 | Temperature rise on continuous operation |  |  |  |
|  | * at rated current |  |  |  |
|  | * at 50°C |  |  |  |
| 2.11 | Rated short-time withstand current (1 s) | kA | 50 |  |
| 2.12 | Rated peak withstand current | kA | 125 |  |
| 2.13 | Test voltage (1 min) | V | 2500 |  |
| 2.14 | Rated insulation voltage | V | 1000 |  |
| 2.15. | Rated impulse withstand voltage | kVp |  |  |
| 2.16 | Overvoltage category |  | IV |  |
| .2.17 | Form of separation |  |  |  |
| 2.18 | Painting | RAL | 7035 |  |
| 2.19 | Type of internal barriers, shutters, etc. |  | Metallic |  |
| 2.20 | Degree of protection |  | IP51 |  |
| 2.21 | Overall dimensions per cubicle |  |  |  |
|  | * Width | mm |  |  |
|  | * Depth | mm |  |  |
|  | * Height | mm | max 2250 |  |
|  | * Weight | kg |  |  |
| 2.22 | Method of circuit breaker withdrawal |  | manual |  |
| **3** | **CIRCUIT BREAKER** |  |  |  |
| 3.1 | Manufacturer |  |  |  |
| 3.2 | Type designation |  |  |  |
| 3.3 | Type |  | Air, withdrawable |  |
| 3.4 | Number of poles |  | 4 |  |
| 3.5 | Standard |  | IEC 60947-2 |  |
| 3.6 | Rated current at 50°C | A |  |  |
| 3.7 | Rated short-time withstand current (1 s) | kA |  |  |
| 3.8 | Rated peak withstand current | kA |  |  |
| 3.9 | Rated symmetrical breaking current | kA |  |  |
| 3.10 | Rated making current | kA |  |  |
| 3.11 | Breaking time | s |  |  |
| 3.12 | Material of: |  |  |  |
|  | * moving contacts |  |  |  |
|  | * fixed contacts |  |  |  |
| 3.13 | Design of: |  |  |  |
|  | * moving contacts |  |  |  |
|  | * fixed contacts |  |  |  |
| 3.14 | Operating mechanism |  |  |  |
|  | * Motor rated power | W |  |  |
|  | * Motor operating voltage | V |  |  |
| 3.15 | Weight of draw-out unit | kg |  |  |
| 3.16 | Protection Module |  |  |  |
|  | * Type |  |  |  |
|  | * Phase protection functions |  | L,S,I |  |
|  | * Neutral protection functions |  |  |  |
|  | * Ground/Earth protection functions |  | G |  |
| 3.17 | Remote Signalling |  | Yes |  |
| 3.18. | Type tests |  | YES |  |
| 3.18.1 | Temperature Rise Test |  |  |  |
|  | Have heating tests at continuous rated normal current been carried out? |  |  |  |
|  | * report number |  |  |  |
|  | * date |  |  |  |
| 3.18.2 | Basic Impulse Voltage Type Test: |  |  |  |
|  | Has B.I.V test been completed? |  |  |  |
|  | * circuit breaker |  |  |  |
|  | * report number |  |  |  |
|  | * date |  |  |  |
| 3.18.3 | Life Test: |  |  |  |
|  | Has 2000 operating life test at no load (de-energised) been carried out? |  |  |  |
|  | * report number |  |  |  |
|  | * date |  |  |  |
| **4** | **MOULDED CASE CIRCUIT BREAKERS (MCCBs)** |  |  |  |
| 4.1 | Manufacturer |  |  |  |
| 4.2 | Type designation |  |  |  |
| 4.3 | Withdrawable MCCBs type |  | yes |  |
| 4.4 | Number of poles |  | 3 |  |
| 4.5 | Standards |  | IEC 60947-2 |  |
| 4.6 | Rated current at 50°C | A |  |  |
| 4.7 | Rated short-time withstand current (1 s) | kA |  |  |
| 4.8 | Rated peak withstand current | kA |  |  |
| 4.9 | Rated breaking current | kA |  |  |
| 4.10 | Remote signalling | Yes/No | Yes |  |
| 4.11 | Operating mechanism |  |  |  |
| 4.12 | Mass |  |  |  |
| 4.13 | Protection Module |  |  |  |
|  | * Type |  |  |  |
|  | * Phase protection functions |  | L, I |  |
|  | * Ground (Earth) protection function |  |  |  |
| **5** | **Current transformers: Note: CT data need to be confirmed by contractor’s calculation** |  |  |  |
| 5.1 | Manufacturer |  |  |  |
| 5.2 | Type |  |  |  |
| 5.3 | Type of primary winding (e.g. bar, wound, etc.) |  |  |  |
| 5.4 | Standards |  | IEC 61869 |  |
| 5.5 | Rated voltage | kV |  |  |
| 5.6 | Rated lightning impulse withstand voltage phase to earth | kV |  |  |
| 5.7 | Rated power frequency withstand voltage phase to earth | kV |  |  |
| 5.8 | Partial discharge test voltage | kV |  |  |
| 5.9 | Rated frequency | Hz | 50 |  |
| 5.10 | Rated continuous thermal current at 50°C |  |  |  |
| 5.11 | Rated short-time withstand current (1 s) | kA |  |  |
| 5.12 | Rated dynamic current | kA |  |  |
| 5.13 | Type designation |  |  |  |
| 5.14 | Number of cores |  | 3 |  |
| 5.15 | Rated extended primary current | % | 120 |  |
| 5.16 | Ratio (TR = turns ratio) |  |  |  |
|  | * I core | A | 750/1  100/1  To be confirmed by calculation |  |
|  | * II core | A | 750/1  100/1  To be confirmed by calculation |  |
|  | * III core | A | 750/1  100/1  To be confirmed by calculation |  |
| 5.17 | Class |  |  |  |
|  | * I core |  | 5P20 |  |
|  | * II core |  | 5P20 |  |
|  | * III core |  | 0.2 / FS:5 |  |
| 5.18 | Knee point voltage (EK) |  |  |  |
|  | * I core | V |  |  |
|  | * II core | V |  |  |
|  | * III core | V |  |  |
| 5.19 | Exciting current (IE) at EK |  |  |  |
|  | * I core | A |  |  |
|  | * II core | A |  |  |
|  | * III core | A |  |  |
| 5.20 | Rated output (burden to be 25-100% rated burden |  |  |  |
|  | * I core | VA | 20 |  |
|  | * II core | VA | 20 |  |
|  | * III core | VA | 20 |  |
| 5.21 | Total mass of one current transformer complete | kg |  |  |
| 5.22 | All Class PX CTs shall have a rated secondary current, ISN |  |  |  |
| **6** | **INSTRUMENTS** |  |  |  |
| 6.1 | Manufacturer |  |  |  |
| 6.2 | Standards |  | IEC 60051 |  |
| 6.3 | Type designation |  |  |  |
|  | * Ammeter |  |  |  |
|  | * Voltmeter |  |  |  |
| 6.4 | Total scale range |  |  |  |
|  | * Ammeter |  |  |  |
|  | * Voltmeter |  |  |  |
| 6.5 | Dimensions | mm | 96 x 96 |  |
| 6.6 | Accuracy |  | 1.5 |  |
| 6.7 | Selector Switches |  |  |  |
|  | * Ammeter |  |  |  |
|  | * Voltmeter |  |  |  |
| **7** | **PROTECTION** |  |  |  |
| **7.1** | **Overcurrent & Earth Fault Protection (50/51/50N/51N) Relay** |  |  |  |
| 7.1.1 | Manufacturer |  |  |  |
| 7.1.2 | Type reference |  |  |  |
| 7.1.3 | Relay design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 7.1.4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88→150 |  |
| .7.1.5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 7.1.6 | Number of phase CT inputs |  |  |  |
| 7.1.7 | Number of earth fault CT inputs |  |  |  |
| 7.1.8 | Characteristics curves conforming to IEC 60255, ANSI | Yes/No | Yes |  |
| 7.1.9 | Number of overcurrent functions (e.g. low set, high set, IDMTL) |  |  |  |
| 7.1.10 | Number of earth fault functions |  |  |  |
| 7.1.11 | Number of group settings |  |  |  |
| 7.1.12 | Earth fault element suitable of high impedance REF (with external resistor) | Yes/No | Yes |  |
| 7.1.13 | Other Requirements |  |  |  |
|  | Integral metering functions | Yes/No |  |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | Event and Fault recording functions | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g. RS232, Ethernet) |  |  |  |
| 7.1.14 | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
| 7.1.15 | Communications |  |  |  |
|  | Control |  |  |  |
|  | Communication ports (Front/Rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| 7.1.16 | Type Tests |  |  |  |
|  | Atmospheric Environment |  |  |  |
|  | * Operation -25°C and 55°C for 96hrs, IEC 60068-2-1 | Yes/No | Yes |  |
|  | * Transport/storage -25°C and 70°C for 96hrs, IEC 60068-2-2 | Yes/No | Yes |  |
|  | Relative Humidity |  |  |  |
|  | * Operation at 93% | Yes/No | Yes |  |
|  | * Tested to IEC 60068-2-3 with severity class 56 days | Yes/No | Yes |  |
|  | Enclosure |  | IP50 |  |
|  | * IEC 60529 |  |  |  |
|  | Mechanical Environment |  |  |  |
|  | * Vibration IEC 60255-21-1 | Yes/No | Yes |  |
|  | * Shock and bump IEC 60255-21-2 | Yes/No | Yes |  |
|  | * Seismic IEC 60255-21-3 | Yes/No | Yes |  |
|  | Insulation |  |  |  |
|  | * Rated insulation |  |  |  |
|  | 1000V high impedance protection CT inputs | Yes/No | Yes |  |
|  | 250V for other circuits | Yes/No | Yes |  |
|  | 1000V open contact withstand | Yes/No | Yes |  |
|  | * Dielectric Tests   IEC 60255-5 – Series C of table 1 | Yes/No | Yes |  |
|  | * Impulse voltage   IEC 60255-5 test voltage 5kV | Yes/No | Yes |  |
|  | Electromagnetic compatibility |  |  |  |
|  | * 1MHz Burst disturbance test,   IEC 60255-22-1 severity class III | Yes/No | Yes |  |
|  | * Electrostatic Discharge   IEC 60255-22-2 severity class III | Yes/No | Yes |  |
|  | * Radiated Electromagnetic Field Disturbance   IEC 60255-22-3 severity class III  Test method A, 27MHz through 500MHz | Yes/No | Yes |  |
|  | * Electromagnetic Emissions IEC 60255-25 | Yes/No | Yes |  |
|  | * Fast Transient Disturbance   IEC 60255-22-4 severity level IV | Yes/No | Yes |  |
|  | Type test certificate provided | Yes/No | Yes |  |
| **7.2** | **Restricted Earth Fault Protection Relay (87NLE)** |  |  |  |
| 7.2.1 | Manufacturer |  |  |  |
| 7.2.2 | Type reference |  |  |  |
| 7.2.3 | Relay design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 7.2.4 | Auxiliary voltage range (V n = 110Vdc) | V dc | 88→150 |  |
| 7.2.5 | Input frequency range (50Hz nominal) | Hz | 47.5→52.5 |  |
| 7.2.6 | Number of phase CT inputs |  |  |  |
| 7.2.7 | Number of earth CT inputs |  |  |  |
| 7.2.8 | Minimum fault setting (% of CT rating) | % |  |  |
| 7.2.9 | Operating time at 5 x setting | ms |  |  |
| 7.2.10 | State principle of operation, i.e.  H - high impedance  L - low impedance | H, L |  |  |
| 7.2.11 | Current transformer requirements: |  |  |  |
|  | * Required knee point voltage, Vk | V |  |  |
|  | * CT maximum winding resistance | Ω |  |  |
|  | * Magnetising current at Vk | A |  |  |
| 7.2.12 | Other protection functions: |  |  |  |
|  | Overvoltage protection (59) | Yes/No | Yes |  |
|  | Under voltage protection | Yes/No | Yes |  |
| 7.2.13 | Other Requirements |  |  |  |
|  | Integral metering functions | Yes/No |  |  |
|  | Programmable logic | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc | 110 |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A | 1 |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | Event and Fault recording functions | Yes/No | Yes |  |
|  | Self-monitoring and alarm facility | Yes/No | Yes |  |
|  | Integral LCD operator interface for local interrogation | Yes/No | Yes |  |
|  | PC based configuration software for HMI, settings, logic and data recorder. | Yes/No | Yes |  |
|  | * Programme name |  |  |  |
|  | * Program included in delivery | Yes/No | Yes |  |
|  | * Type of interface at relay (e.g. RS232, Ethernet) |  |  |  |
| 7.2.14 | Tripping contacts rating |  |  |  |
|  | * Carry continuous | A | 5 |  |
|  | * Make I (A) maximum for t (s) | A/s | 30 / 0.5 |  |
|  | * Break dc: W resistive/W inductive (L/R = 40ms) | W/W | 40 / 25 |  |
| 7.2.15 | Communications |  |  |  |
|  | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | * IEC 61850 | Yes/No | Yes |  |
|  | * Others (please state) |  |  |  |
| **7.3** | **Under voltage Relay** |  |  |  |
| 7.3.1. | Manufacturer |  |  |  |
| 7.3.2. | Type reference |  |  |  |
| 7.3.3. | Relay design (electromechanical, static) |  | static |  |
| 7.3.4. | Total scale range | V |  |  |
| 7.3.5. | Operate time at instantaneous voltage change | ms |  |  |
| 7.3.6. | Reset ratio | % |  |  |
| 8 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 9 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available not older than 5 years | Yes/No | Yes |  |

# DIESEL GENERATOR

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| **15.1** | **General** |  |  |  |
| 1 | Design Ambient Temperature | ̊C(min), ̊C(max) | According to General requirements document |  |
| 2 | Humidity | % | According to General requirements document |  |
| 3 | Installation |  | indoor |  |
| 4 | Electrical system |  |  |  |
|  | Alternator |  |  |  |
|  | Model |  |  |  |
|  | AVR Model |  |  |  |
|  | Rated Cont. Power Output- Rating shall be confirm by EPC as per actual requirement of substation load | KW | 250 |  |
|  | Rated Voltage (no load) | V , % | 415 , ±5 |  |
|  | Alternator Matched to Engine Output |  | yes |  |
|  | Main Exciter(brushless) |  | yes |  |
|  | Earthing |  | Solidly grounded |  |
|  | Over Speed Rating | % | 120 |  |
| 5 | Control instruments |  |  |  |
|  | Control Card | Yes/No | yes |  |
|  | Auto Start-up, Mains Failure | Yes/No | yes |  |
|  | Manual Start-up | Yes/No | yes |  |
|  | Alarms |  |  |  |
|  | Start-up Failure | Yes/No | yes |  |
|  | Battery Change Failure | Yes/No | yes |  |
|  | Start-up Failure | Yes/No | yes |  |
|  | Battery Change Failure | Yes/No | yes |  |
|  | Low Oil Pressure | Yes/No | yes |  |
|  | High Engine Water Temperature | Yes/No | yes |  |
|  | Low Fuel Level | Yes/No | yes |  |
|  | Low Radiator Water Level | Yes/No | yes |  |
|  | Emergency Stop | Yes/No | yes |  |
|  | Over speed | Yes/No | yes |  |
|  | Protection device |  |  |  |
|  | Emergency Stop Button | Yes/No | yes |  |
|  | ATS (optional) |  |  |  |
| **2** | **A.C. Generator** |  |  |  |
| 2.1 | General |  |  |  |
|  | Manufacturer |  | To be specified by Bidder |  |
|  | Country |  | To be specified by Bidder |  |
| 2.2 | Degree Of Protection For GEN |  | Ip23 |  |
| 2.3 | Degree Of Protection For Term Box |  | Ip55 |  |
| 2.4 | Type designation |  |  |  |
| 2.5 | Number of Poles |  |  |  |
| 2.6 | Class of insulation: |  |  |  |
|  | Stator |  |  |  |
|  | Rotor |  |  |  |
| 2.7 | Rated voltage | V rms | 415 , 3ph , ±5% |  |
| 2.8 | Rated current | A rms |  |  |
| 2.9 | Rated power out put | KW | 250 |  |
| 2.10 | Rated Power Factor | lag | 0.8 |  |
| 2.11 | Total Harmonic Distortion | % | <3 |  |
| 2.12 | Over-load rating and time duration | kW.h |  |  |
| 2.13 | Short circuit withstand in 1 second (with submission of calculation) | kA (rms) |  |  |
| 2.14 | Rated frequency | HZ | 50 , ±2 |  |
| 2.15 | Emergency Standby Duty | Yes/No | yes |  |
| 2.16 | Time to Accept Full Load After Start up | % step load , sec | 100 / 10 |  |
| 2.17 | Load in % of Rated Continuous Power | % | 25,50,75,100,110 |  |
| 2.18 | Voltage stability equipment and range |  |  |  |
| 2.19 | frequency stability equipment and range |  |  |  |
| 2.20 | Connection of windings |  |  |  |
| 2.21 | Neutral grounding |  |  |  |
| 2.22 | Is generator brushless? |  |  |  |
| 2.23 | Number of Phases |  |  |  |
| 2.24 | Reactance: |  |  |  |
| 2.25 | Synchronous Xd | % |  |  |
| 2.26 | Transient X'd | % |  |  |
| 2.27 | Sub-transient X''d | % |  |  |
| 2.28 | Type of cooling |  |  |  |
| 2.29 | Efficiency at rated voltage and frequency: |  |  |  |
| 2.30 | 75% rated load |  |  |  |
| 2.31 | 100% rated load |  |  |  |
| 2.32 | Exciter details: |  |  |  |
| 2.33 | Manufacturer |  |  |  |
| 2.34 | Power rating | kW |  |  |
| 2.35 | Voltage rating | V-DC |  |  |
| 2.36 | Max. instantaneous change in frequency for instantaneous load change from zero to full load |  |  |  |
| **3** | **Diesel Engine** |  |  |  |
| 3.1 | Manufacture |  |  |  |
| 3.2 | Country |  |  |  |
| 3.3 | Type designation |  |  |  |
| 3.4 | Number of cylinders |  | 6 |  |
| 3.5 | Speed | r.p.m | 1500 |  |
| 3.6 | Type of cooling |  |  |  |
| 3.7 | Compression Ratio |  | By vendor |  |
| 3.8 | Coupling |  |  |  |
| 3.9 | Start-up time from initiation until circuit breaker closes | S |  |  |
| 3.10 | Number of strokes |  |  |  |
| 3.11 | Compression ratio |  |  |  |
| 3.12 | Efficiency at rated load | % |  |  |
| 3.13 | Fuel Type |  | HSD |  |
| 3.14 | Rated Overload Power(1hr in 24 hr) | % of Rated Load | 110 |  |
| 3.15 | Cylinders Wet or Dry |  | wet |  |
| 3.16 | Frame |  | cast |  |
| 3.17 | Starter Motor |  |  |  |
| 3.18 | Fuel Tank Capacity |  |  |  |
| 3.19 | Fuel injection system |  |  |  |
| 3.20 | Specific fuel consumption at:(Based on generation output) |  |  |  |
| 3.21 | Aspiration (Natural or supercharger) |  |  |  |
| 15.3.22 | Engine safety shutdown with alarm & indication |  |  |  |
| 3.23 | Engine Over Speed | Yes/No | yes |  |
| 3.24 | Low lube Oil Pressure | Yes/No | yes |  |
| 3.25 | High Jacket Water Temperature | Yes/No | yes |  |
| 3.26 | Fuel Engine Leakage | Yes/No | yes |  |
| 3.27 | Flow of Air From Fan | m³/min |  |  |
| 3.28 | Water Jacket Heater | Yes/No | yes |  |
| 3.29 | Lubrication system |  |  |  |
| 3.30 | Maximum Oil Consumption (% Fuel Consumption) |  | 0.2 |  |
| **4** | **Governor** |  |  |  |
| 4.1 | Type | Electric/Hydraulic | Electronic |  |
| 4.2 | Manufacturer and country |  | To be specified by Bidder |  |
| **5** | **Starting system** |  |  |  |
| 5.1 | Type of the battery |  |  |  |
| 5.2 | Number of Batteries |  | 1 |  |
| 5.3 | ‍Capacity of the battery | Ah |  |  |
| 5.4 | Rated voltage of the battery | V DC | 24 |  |
| 5.5 | Type of starter |  |  |  |
| 5.6 | Type of charger |  |  |  |
| 5.7 | charger voltage supply |  |  |  |
| **6** | **‍Control and indication** |  |  |  |
| 6.1 | Type of control cubicle (local console or control panel) |  |  |  |
| 6.2 | Number and type of alarms |  |  |  |
| 6.3 | Number and type of alarms |  |  |  |
| 6.4 | Type of remote alarms |  |  |  |
| 6.5 | Metering equipment (manufacturer, type and range): |  |  |  |
|  | A.C. ammeter |  |  |  |
|  | A.C. voltmeter |  |  |  |
|  | Frequency-meter |  |  |  |
|  | Water temperature indicator |  |  |  |
|  | Oil pressure indicator |  |  |  |
|  | Running hour-meter |  |  |  |
| 6.6 | Control switches and knobs (manufacturer and type) |  |  |  |
| 6.7 | Protective relaying (manufacturer and type) |  |  |  |
| 6.8 | Circuit breaker (contactor): |  |  |  |
|  | Manufacturer and type |  |  |  |
|  | Current rating | A(rms) |  |  |
| **7** | **Weight and dimension** |  |  |  |
| 7.1 | Main fuel tank |  |  |  |

# 110 V D.C SYSTEM

| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| **1** | **110 V Battery Units** |  |  |  |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Type designation |  |  |  |
| 1.3 | Number of battery units |  | 2 x 50% |  |
| 1.4 | Type of cell |  | Nickel-Cadmium |  |
| 1.5 | Operating voltage per cell | V | 1.2 |  |
| 1.6 | Number of cells |  | 92 |  |
| 1.7 | Discharge capacity: |  |  |  |
|  | 10 hour’s rate | Ah | min. 800(to be confirmed by calculation) |  |
|  | * 5 hour’s rate | Ah |  |  |
|  | * 3 hour’s rate | Ah |  |  |
|  | * 1 hour’s rate | Ah |  |  |
|  | * 30 minute’s rate | Ah |  |  |
| 1.8 | Final cell voltage after discharge: |  |  |  |
|  | * 10 hour’s rate | V | 1.14 |  |
|  | * 5 hour’s rate | V |  |  |
|  | * 3 hour’s rate | V |  |  |
|  | * 1 hour’s rate | V |  |  |
|  | * 30 minute’s rate | V |  |  |
| 1.9 | Ampere hour efficiency: |  |  |  |
|  | * 10 hour’s rate | % |  |  |
|  | * 5 hour’s rate | % |  |  |
|  | * 3 hour’s rate | % |  |  |
|  | * 1 hour’s rate | % |  |  |
| 1.10 | Watt hour efficiency: |  |  |  |
|  | * 10 hour’s rate | % |  |  |
|  | * 5 hour’s rate | % |  |  |
|  | * 3 hour’s rate | % |  |  |
|  | * 1 hour’s rate | % |  |  |
|  | * 30 minute’s rate | % |  |  |
| 1.11 | Maximum charging voltage per cell | V |  |  |
| 1.12 | Normal charging rate range | A |  |  |
| 1.13 | Maximum charging rate range | A |  |  |
| 1.14 | Float charging rate | A |  |  |
| 1.15 | Boost charging rate | A |  |  |
| 1.16 | Normal voltage across battery on float charge | V |  |  |
| 1.17 | Voltage per cell on float charge | V |  |  |
| 1.18 | Normal voltage across battery on boost charge | V |  |  |
| 1.19 | Voltage per cell on boost charge | V |  |  |
| 1.20 | Overall dimensions of one cell | mm |  |  |
| 1.21 | Quantity of electrolyte per cell | Litres |  |  |
| 1.22 | Overall dimensions of each stand | mm |  |  |
| 1.23 | Number of stands |  |  |  |
| 1.24 | Number of tiers |  |  |  |
| 1.25 | Material and cross section of connections: |  |  |  |
|  | * between cells | mm2 |  |  |
|  | * between tiers | mm2 |  |  |
|  | * between stands | mm2 |  |  |
|  | * to battery fuse box | mm2 |  |  |
| 1.26 | Method of treating copper connection against corrosion |  |  |  |
| 1.27 | Method of protecting copper connections against accidental short circuiting |  |  |  |
| 1.28 | Estimated short circuit current from fully charged battery | A |  |  |
| 1.29 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 1.30 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 1.31 | Operating temperatures: |  |  |  |
|  | * Normal operation maximum | °C |  |  |
|  | * Normal operation minimum | °C |  |  |
|  | * Emergency discharge maximum | °C |  |  |
|  | * Emergency discharge minimum | °C |  |  |
|  | * Standard |  | \* IEEE 1115 for calculation  \* IEC 60623, 61204, 61439 for equipment |  |
| **2** | **110 V D.C Battery Chargers** |  |  |  |
| 2.1 | Manufacturer |  |  |  |
| 2.2 | Type designation |  | hot swappable rectifier modules |  |
| 2.3 | Panel |  |  |  |
|  | * Degree of protection |  | IP 51 |  |
|  | * Painting | RAL | 7035 |  |
| 2.4 | Number of chargers |  | 2 x 100% |  |
| 2.5 | Type |  | Thyristor Controlled |  |
| 2.6 | Charging characteristic |  |  |  |
| 2.7 | Input voltage and range | V | 3 Phase, 415, ±25% |  |
| 2.8 | Input frequency and range | Hz | 50, ±5% |  |
| 2.9 | Input power | kVA |  |  |
| 2.10 | Minimum working power factor |  |  |  |
| 2.11 | Rated output power | kW |  |  |
| 2.12 | Output voltage range: |  |  |  |
|  | * float charge | V |  |  |
|  | * boost charge | V |  |  |
| 2.13 | Continuous output current range: |  |  |  |
|  | * float charge | A | 250 minimum |  |
|  | * boost charge | A |  |  |
| 2.14 | DC output voltage regulation with 0 to 100 % load, +/- 10 % input voltage variation and +/- 5 % frequency variation | % | 1 |  |
| 2.15 | Overload range | % |  |  |
| 2.16 | Maximum ripple without battery | % | 5max |  |
| 2.17 | Ripple frequency | Hz |  |  |
| 2.18 | Floating range | Vdc | 105 - 150 |  |
| 2.19 | Equalizing range | Vdc | 105 - 150 |  |
| 2.20 | Equalizing time delay setting  range | hours | 6 - 48 |  |
| 2.21 | Means of adjusting output |  |  |  |
| 2.22 | Details of any forced cooling equipment for chargers |  |  |  |
| 2.23 | Ambient temperature range | °C |  |  |
| 2.24 | Ambient relative humidity range | % |  |  |
| 2.25 | Mean time between failure (MTBF) | Years | 25 |  |
| 2.25 | Overall dimensions (shall be a separate free-standing panel/cubicle) | mm |  |  |
| 2.26 | Weight | kg |  |  |
| 2.27 | Boost charge maximum permitted constant potential per cell | V |  |  |
| 2.28 | Boost charge maximum permitted current as percentage of 5 hour capacity | % |  |  |
| 2.29 | Time to be re-charge to 90% capacity at maximum permitted voltage and current | hrs |  |  |
| 2.30 | Type of protections : |  |  |  |
|  | AC phase failure | Yes/No | Yes |  |
|  | AC phase sequence | Yes/No | Yes |  |
|  | Blocking diode | Yes/No | Yes |  |
| 2.31 | Dropper |  |  |  |
|  | Inrush current | Yes/No | Yes |  |
|  | Battery reverse | Yes/No | Yes |  |
|  |  |  |  |  |
| 2.32 | Alarm & Indications : |  |  |  |
|  | Over voltage alarm for AC/ DC | Yes/No | Yes |  |
|  | Under voltage alarm for AC/ DC | Yes/No | Yes |  |
|  | Current indication for AC/ DC | Yes/No | Yes |  |
| 2.33 | Automatic changeover operation provided in charger | Yes/No | Yes |  |
| 2.34 | Charger can be parallel to another | Yes/No | Yes |  |
| 2.35 | charger efficiency |  | Min 96% |  |
| **3** | **Battery Fuse Boxes in control house** |  |  |  |
| 3.1 | Manufacturer |  |  |  |
| 3.2 | Type designation |  |  |  |
| 3.3 | Degree of protection |  | IP 51 |  |
| 3.4 | Fuse rated current at 50oC |  |  |  |
| 3.5 | Remote signalling | Yes/No | Yes |  |
| 3.6 | Dimensions of box | mm |  |  |
| **4** | **110 V D.C. Switchboards** |  |  |  |
| 4.1 | Manufacturer |  |  |  |
| 4.2 | Type designation |  |  |  |
| 4.3 | Panels |  |  |  |
|  | * Degree of protection |  | IP 51 |  |
|  | * Painting | RAL | 7035 |  |
|  | * Form of separation |  | 3b |  |
| 4.4 | Standards |  | IEC 61439 |  |
| 4.5 | Rated operating voltage | V | 110 |  |
| 4.6 | Rated current of bus bars at 50oC ambient temperature | A |  |  |
| 4.7 | Bus bar cross section | mm2 |  |  |
| 4.8 | Bus bar insulation material |  |  |  |
| 4.9 | Number of circuits |  |  |  |
| 4.10 | Main isolator rating | A |  |  |
| 4.11 | Main fuse rating | A |  |  |
| 4.12 | Single line diagram number |  |  |  |
| 4.13 | Arrangement drawing number |  |  |  |
| 4.14 | Details of Contactors: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Type |  |  |  |
|  | * Site current rating (at 50°C) | A |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Short time current (1 s) | kA |  |  |
|  | * Maximum operating time opening | Msec |  |  |
|  | * Maximum operating time closing | msec |  |  |
|  | * Voltage / power coil rating | V/W |  |  |
|  | * Typical circuit diagram number |  |  |  |
| 4.15 | Details of Earth Fault Protection: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type Designation |  |  |  |
|  | * Brochure number |  |  |  |
| 4.16 | Details of Under-voltage / Overvoltage Protection: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type Designation |  |  |  |
|  | * Brochure number |  |  |  |
| 4.17 | Instruments |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Voltmeter (type) |  |  |  |
|  | * Ammeter (type) |  |  |  |
|  | * Instruments |  |  |  |
| 4.18 | Details of Moulded Case Circuit Breakers (MCCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 50°C | A |  |  |
|  | * Rated short-time withstand current (1 s) | kA |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 4.19 | Details of Miniature Circuit Breakers (MCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 50°C | A |  |  |
|  | * Rated short-time withstand current (1 s) | kA |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 4.20 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 4.21 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |

# 48 V D.C SYSTEM

| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| **1** | **48 V Battery Units** |  |  |  |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Type designation |  |  |  |
| 1.3 | Number of battery units |  | 2 x 50% |  |
| 1.4 | Type of cell |  | Nickel-Cadmium |  |
| 1.5 | Operating voltage per cell | V | 1.2 |  |
| 1.6 | Number of cells |  | 40 |  |
| 1.7 | Standard |  | \* IEEE 1115 for calculation  \* IEC 60623, 61204, 61439 for equipment |  |
| 1.8 | Discharge capacity: |  |  |  |
|  | * 10 hour’s rate | Ah | 300 (to be confirmed by calculation) |  |
|  | * 5 hour’s rate | Ah |  |  |
|  | * 3 hour’s rate | Ah |  |  |
|  | * 1 hour’s rate | Ah |  |  |
|  | * 30 minute’s rate | Ah |  |  |
| 1.9 | Final cell voltage after discharge: |  |  |  |
|  | * 10 hour’s rate | V | 1.14 |  |
|  | * 5 hour’s rate | V |  |  |
|  | * 3 hour’s rate | V |  |  |
|  | * 1 hour’s rate | V |  |  |
|  | * 30 minute’s rate | V |  |  |
| 1.10 | Ampere hour efficiency: |  |  |  |
|  | * 10 hour’s rate | % |  |  |
|  | * 5 hour’s rate | % |  |  |
|  | * 3 hour’s rate | % |  |  |
|  | * 1 hour’s rate | % |  |  |
| 1.11 | Watt hour efficiency: |  |  |  |
|  | * 10 hour’s rate | % |  |  |
|  | * 5 hour’s rate | % |  |  |
|  | * 3 hour’s rate | % |  |  |
|  | * 1 hour’s rate | % |  |  |
|  | * 30 minute’s rate | % |  |  |
| 1.12 | Maximum charging voltage per cell | V |  |  |
| 1.13 | Normal charging rate range | A |  |  |
| 1.14 | Maximum charging rate range | A |  |  |
| 1.15 | Float charging rate | A |  |  |
| 1.16 | Boost charging rate | A |  |  |
| 1.17 | Normal voltage across battery on float charge | V |  |  |
| 1.18 | Voltage per cell on float charge | V |  |  |
| 1.19 | Normal voltage across battery on boost charge | V |  |  |
| 1.20 | Voltage per cell on boost charge | V |  |  |
| 1.21 | Overall dimensions of one cell | mm |  |  |
| 1.22 | Quantity of electrolyte per cell | Litres |  |  |
| 1.23 | Overall dimensions of each stand | mm |  |  |
| 1.24 | Number of stands |  |  |  |
| 1.25 | Number of tiers |  |  |  |
| 1.26 | Material and cross section of connections: |  |  |  |
|  | * between cells | mm2 |  |  |
|  | * between tiers | mm2 |  |  |
|  | * between stands | mm2 |  |  |
|  | * to battery fuse box | mm2 |  |  |
| 1.27 | Method of treating copper connection against corrosion |  |  |  |
| 1.28 | Method of protecting copper connections against accidental short circuiting |  |  |  |
| 1.29 | Estimated short circuit current from fully charged battery | A |  |  |
| 1.30 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 1.31 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 1.32 | Operating temperatures: |  |  |  |
|  | * Normal operation maximum | °C |  |  |
|  | * Normal operation minimum | °C |  |  |
|  | * Emergency discharge maximum | °C |  |  |
|  | * Emergency discharge minimum | °C |  |  |
| **2** | **48 V D.C Battery Chargers** |  |  |  |
| 2.1 | Manufacturer |  |  |  |
| 2.2 | Type designation |  | hot swappable rectifier modules |  |
| 17.2.3 | Panel |  |  |  |
|  | * Degree of protection |  | IP 51 |  |
|  | * Painting | RAL | 7035 |  |
| 2.4 | Number of chargers |  | 2 x 100% |  |
| 2.5 | Type |  | Thyristor Controlled |  |
| 2.6 | Charging characteristic |  |  |  |
| 2.7 | Input voltage and range | V | 3 Phase, 415, ±25% |  |
| 2.8 | Input frequency and range | Hz | 50, ±5% |  |
| 2.9 | Input power | kVA |  |  |
| 2.10 | Minimum working power factor |  |  |  |
| 2.11 | Rated output power | kW |  |  |
| 2.12 | Output voltage range: |  |  |  |
|  | * float charge | V |  |  |
|  | * boost charge | V |  |  |
| 2.13 | Continuous output current range: |  |  |  |
|  | * float charge | A | 85 minimum |  |
|  | * boost charge | A |  |  |
| 2.14 | * DC output voltage regulation with 0 to 100 % load, +/- 10 % input voltage variation and +/- 5 % frequency variation | % | 5% |  |
| 2.15 | Overload range | % |  |  |
| 2.16 | Voltage ripple | % |  |  |
| 2.17 | Ripple frequency | Hz |  |  |
| 2.18 | Floating range | Vdc | 40 – 60 |  |
| 2.19 | Equalizing range | Vdc | 40 – 60 |  |
| 2.20 | Equalizing time delay setting  range | hours | 6 - 48 |  |
| 2.21 | Means of adjusting output |  |  |  |
| 2.22 | Details of any forced cooling equipment for chargers |  |  |  |
| 2.23 | Ambient temperature range | °C |  |  |
| 2.24 | Ambient relative humidity range | % |  |  |
| 2.25 | Mean time between failure (MTBF) | Years | 25 |  |
| 2.26 | Overall dimensions (shall be a separate free-standing panel/cubicle) | mm |  |  |
| 2.27 | Weight | kg |  |  |
| 2.28 | Boost charge maximum permitted constant potential per cell | V |  |  |
| 2.29 | Boost charge maximum permitted current as percentage of 5 hour capacity | % |  |  |
| 2.30 | Time to be re-charge to 90% capacity at maximum permitted voltage and current | hrs |  |  |
| 2.31 | Type of protections : |  |  |  |
|  | AC phase failure | Yes/No | Yes |  |
|  | AC phase sequence | Yes/No | Yes |  |
|  | Blocking diode | Yes/No | Yes |  |
| 2.32 | Dropper |  |  |  |
|  | Inrush current | Yes/No | Yes |  |
|  | Battery reverse | Yes/No | Yes |  |
|  |  |  |  |  |
| 2.33 | Alarm & Indications : |  |  |  |
|  | Over voltage alarm for AC/ DC | Yes/No | Yes |  |
|  | Under voltage alarm for AC/ DC | Yes/No | Yes |  |
|  | Current indication for AC/ DC | Yes/No | Yes |  |
| 2.34 | Automatic changeover operation provided in charger | Yes/No | Yes |  |
| 2.35 | Charger can be parallel to another | Yes/No | Yes |  |
| 2.36 | charger efficiency |  | Min 96% |  |
| **3** | **Battery Fuse Boxes** |  |  |  |
| 3.1 | Manufacturer |  |  |  |
| 3.2 | Type designation |  |  |  |
| 3.3 | Degree of protection |  | IP 51 |  |
| 3.4 | Fuse rated current at 50oC |  |  |  |
| 3.5 | Remote signalling | Yes/No | Yes |  |
| 3.6 | Dimensions of box | mm |  |  |
| **4** | **48 V D.C. Switchboards** |  |  |  |
| 4.1 | Manufacturer |  |  |  |
| 4.2 | Type designation |  |  |  |
| 4.3 | Panels |  |  |  |
|  | * Degree of protection |  | IP 51 |  |
|  | * Painting | RAL | 7035 |  |
|  | * Form of separation |  | 3b |  |
| 4.4 | Standards |  | IEC 61439 |  |
| 4.5 | Rated operating voltage | V | 48 |  |
| 4.6 | Rated current of bus bars at 50°C ambient temperature | A |  |  |
| 4.7 | Bus bar cross section | mm2 |  |  |
| 4.8 | Bus bar insulation material |  |  |  |
| 4.9 | Number of circuits |  |  |  |
| 4.10 | Main isolator rating | A |  |  |
| 4.11 | Main fuse rating | A |  |  |
| 4.12 | Single line diagram number |  |  |  |
| 4.13 | Arrangement drawing number |  |  |  |
| 4.14 | Details of Contactors: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Type |  |  |  |
|  | * Site current rating (at 50°C) | A |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Short time current (1 s) | kA |  |  |
|  | * Maximum operating time opening | msec |  |  |
|  | * Maximum operating time closing | msec |  |  |
|  | * Voltage / power coil rating | V/W |  |  |
|  | * Typical circuit diagram number |  |  |  |
| 4.15 | Details of Earth Fault Protection: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type Designation |  |  |  |
|  | * Brochure number |  |  |  |
| 4.16 | Details of Under voltage / Overvoltage Protection: |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type Designation |  |  |  |
|  | * Brochure number |  |  |  |
| 4.17 | Instruments |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Voltmeter (type) |  |  |  |
|  | * Ammeter (type) |  |  |  |
|  | * Instruments |  |  |  |
| 4.18 | Details of Moulded Case Circuit Breakers (MCCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 50°C | A |  |  |
|  | * Rated short-time withstand current (1 s) | kA |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 4.19 | Details of Miniature Circuit Breakers (MCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 50°C | A |  |  |
|  | * Rated short-time withstand current (1 s) | kA |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 4.20 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 4.21 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| **5** | **240 V AC UNINTERRUPTIBLE POWER SUPPLY** |  |  |  |
| **5.1** | **GENERAL** |  |  |  |
| 5.1.1 | The uninterruptible power supply (UPS) shall consist but not be limited to the following items FOR Control building |  |  |  |
|  | * Two thyristor controlled 110 V DC / 240 V AC inverters | Yes/No | Yes |  |
|  | * two static interrupters and transfer switches | Yes/No | Yes |  |
|  | * one 240/240 V single phase isolating by-pass transformer | Yes/No | Yes |  |
|  | * two manual by-pass switches | Yes/No | Yes |  |
|  | * one UPS distribution board | Yes/No | Yes |  |
| **5.2** | **INVERTER – CONTROL BUILDING** |  |  |  |
| 5.2.1 | Manufacturer |  |  |  |
| 5.2.2 | Type designation |  |  |  |
| 5.2.3 | Degree of protection/RAL code |  | IP51/RAL 7035 |  |
| 5.2.4 | Rated output power | VA | min 4000 (to be confirmed by calculation) |  |
| 5.2.5 | Rated input voltage and range | V±% |  |  |
| 5.2.6 | Rated input current | A |  |  |
| 5.2.7 | Rated output voltage | V |  |  |
| 5.2.8 | Steady state voltage variation | % |  |  |
| 5.2.9 | Rated output current | A |  |  |
| 5.2.10 | Rated output frequency | Hz |  |  |
| 5.2.11 | Steady state frequency variation | % |  |  |
| 5.2.12 | Total harmonic distortion | % |  |  |
| 5.2.13 | Rated output power factor |  |  |  |
| 5.2.14 | Maximum harmonic distortion: |  |  |  |
|  | * at any single frequency | % |  |  |
|  | * at all frequencies | % |  |  |
| 5.2.15 | Radio frequency interference (RFI) classification |  |  |  |
| 5.2.16 | Output voltage rise time on turn-on | ms |  |  |
| 5.2.17 | Output voltage decay time on turn-off | ms |  |  |
| 5.2.18 | Maximum transient voltage variation after full load acceptance or rejection for: |  |  |  |
|  | * 1 cycle | % |  |  |
|  | * 0.1 s | % |  |  |
|  | * 1 s | % |  |  |
| 5.2.19 | Method of cooling |  |  |  |
| 5.2.20 | Ambient temperature range | °C |  |  |
| 5.2.21 | Maximum temperature rise (inside) | °C |  |  |
| 5.2.22 | Ambient relative humidity | % |  |  |
| 5.2.23 | Method of protecting inverters against high intensity D.C voltage surges |  |  |  |
| 5.2.24 | Mean time between failure (MTBF) | Years | 25 |  |
| 5.2.25 | Dimensions | mm |  |  |
| 5.2.26 | Weight | kg |  |  |
| **5.3** | **STATIC SWITCH – CONTROL BUILDING** |  |  |  |
| 5.3.1 | Bidder shall fulfil the detailed description of offered static switch possibility with data and diagram |  |  |  |
| **5.4** | **ISOLATION BY-PASS TRANSFORMER -CONTROL BUILDING** |  |  |  |
| 5.4.1 | Manufacturer |  |  |  |
| 5.4.2 | Standard applied |  |  |  |
| 5.4.3 | Type designation |  |  |  |
| 5.4.4 | Maximum continuous capacity | VA |  |  |
| 5.4.5 | Number of phase | 1 |  |  |
| 5.4.6 | Rated voltage under full load | V |  |  |
| 5.4.7 | Protection class | IP |  |  |
| 5.4.8 | Dimensions overall | mm |  |  |
| 5.4.9 | Total weight | kg |  |  |
| **5.5** | **MANUAL BY-PASS SWITCH** |  |  |  |
| 5.5.1 | Manufacturer |  |  |  |
| 5.5.2 | Type of designation |  |  |  |
| 5.5.3 | Rated current at 50°C | A |  |  |
| **5.6** | **DISTRIBUTION BOARD** |  |  |  |
| 5.6.1 | Manufacturer |  |  |  |
| 5.6.2 | Type designation |  |  |  |
| 5.6.3 | Degree of protection/RAL code |  | IP 51/RAL 7035 |  |
| 5.6.4 | Bus bar insulation material |  |  |  |
| 5.6.5 | Number of circuits |  |  |  |
| 5.6.6 | Details of Miniature Circuit Breakers (MCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 40°C | A |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 5.6.7 | Details of Moulded Case Circuit Breakers (MCCBs) |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Type designation |  |  |  |
|  | * Number of poles |  |  |  |
|  | * Standards |  |  |  |
|  | * Rated current at 40°C | A |  |  |
|  | * Rated breaking capacity | kA |  |  |
|  | * Remote signalling | Yes/No | Yes |  |
| 5.7 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 5.8 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| **6** | **AUXILIARY BCU – CONTROL BUILDING** |  |  |  |
|  | Hardware and software type same as BCUs specified | Yes/No | Yes |  |
|  | Binary Inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Nominal voltage | Vdc |  |  |
|  | * Maximum permissible voltage | Vdc |  |  |
|  | Binary Outputs |  |  |  |
|  | * Number |  |  |  |
|  | CT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated current | A |  |  |
|  | * Power consumption | VA |  |  |
|  | VT analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Rated voltage | Vac | 110 |  |
|  | * Power consumption | VA |  |  |
|  | mA analog inputs |  |  |  |
|  | * Number |  |  |  |
|  | * Range | mA | 4-20 |  |

# EARTHING AND LIGHTNING PROTECTION



## EARTHING SYSTEM- Size of conductor will be confirmed by calculation

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1. | Manufacturers |  |  |  |
| 2. | Standard Applied  The following standards shall apply to the earthing installations and to the accessories: |  |  |  |
|  | * Guide for safety in A.C. substation grounding |  | IEEE80 & 81 |  |
|  | * Earthing system in A.C. installation for rated voltages above 1000 V |  | VDE 0141 |  |
| 3. | Physical Properties of Copper |  |  |  |
|  | The most important physical properties of copper used for the earthing conductors: |  |  |  |
|  | * Density | kg/dm3 | 8.89 |  |
|  | * Electrical resistivity at 20°C | Ωmm2/m | 0.0176 |  |
|  | * Melting point | °C | 1083 |  |
|  | * Current density at which the conductor temperature rises from 50°C to 300°C in a time of 1 s if all heat is retained in conductor | A/mm2 | 190 |  |
| .4. | Physical Properties of Lead-Sheathed Copper |  |  |  |
|  | The most important physical properties of lead-sheathed copper used for the earth electrodes: |  |  |  |
|  | * Thickness of lead sheath | mm | 2.0 |  |
|  | * Electrical resistivity of copper at 20°C | Ωmm2/m | 0.0176 |  |
|  | * Copper melting point | °C | 1083 |  |
|  | * Lead melting point | °C | 327 |  |
|  | * Current density at which the conductor temperature rises from 40°C to 150°C in a time of 1 s if all heat is retained in conductor | A/mm2 | 140 |  |
| 5. | Earthing Conductors |  |  |  |
| 5.1 | Stranded copper clad steel conductors |  |  |  |
|  | The following stranded copper conductor will be used as earthing conductors: |  |  |  |
|  | * Minimum cross-section area – 400KV   to be confirmed by calculation   * Minimum cross-section area – 132KV   to be confirmed by calculation | mm2  mm2 | 150  120 |  |
|  | * Number of wires | No. |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
|  | * Minimum cross-section area   to be confirmed by calculation | mm2 |  |  |
|  | * Number of wires | No. |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
|  | * Minimum cross-section area   to be confirmed by calculation | mm |  |  |
|  | * Number of wires | pcs |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
| 5.2 | Copper Flat Bars |  |  |  |
|  | The following copper flat bars will be used as earthing conductors: |  |  |  |
|  | * Cross section area | mm2 |  |  |
|  | * Dimensions | mm x mm |  |  |
|  | * Density | kg/m |  |  |
|  | * Cross section area | mm2 |  |  |
|  | * Dimensions | mm x mm |  |  |
|  | * Density | kg/m |  |  |
|  |  |  |  |  |
|  | * Cross section area | mm2 |  |  |
|  | * Dimensions | mm x mm |  |  |
|  | * Density | kg/m |  |  |
| 5.3 | Copper Cables |  |  |  |
|  | The following PVC single-core copper cables will be used as earthing conductors: |  |  |  |
|  | * Cross-section area | mm2 |  |  |
|  | * Cross-section area | mm2 |  |  |
|  | * Cross-section area | mm2 |  |  |
| 6. | Earth Electrodes |  |  |  |
| 6.1 | Lead-sheathed stranded copper conductors |  |  |  |
|  | The following lead-sheathed stranded copper conductor will be used as earth electrodes: |  |  |  |
|  | * Thickness of lead sheath | mm |  |  |
|  | * Copper cross-section area | mm2 |  |  |
|  | * Number of wires | pcs |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
|  | * Thickness of lead sheath | mm |  |  |
|  | * Copper cross-section area | mm2 |  |  |
|  | * Number of wires | pcs |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
|  | * Thickness of lead sheath | mm |  |  |
|  | * Copper cross-section area | mm2 |  |  |
|  | * Number of wires |  |  |  |
|  | * Diameter of each wire | mm |  |  |
|  | * Conductor diameter | mm |  |  |
|  | * Density | kg/m |  |  |
| 6.2 | Earth rod |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Length | m |  |  |
|  | * Diameter | mm |  |  |
|  | * Material (copper, stainless steel) |  |  |  |
| 6.3 | Stainless steel electrodes |  |  |  |
|  | The following steel flat bars will be used as earth electrodes: |  |  |  |
|  | * Cross-section area | mm2 |  |  |
|  | * Dimensions | mm x mm |  |  |
|  | * Density | kg/m |  |  |
| 7 | Connections |  |  |  |
|  | Mode of Connection in the Earthing Systems: |  |  |  |
|  | * Between earthing conductors and earth electrodes |  | Brazed |  |
|  | * Crossing of earth electrodes |  | cad welded |  |
| 8 | Maximum Resistance of Earthing/Grounding System | Ohm | 1 |  |

## LIGHTNING PROTECTION

Size of conductor will be confirmed by calculation

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1. | Manufacturers |  |  |  |
| 2. | Standard Applied: |  |  |  |
|  | * Protection of structures against lightning |  | IEC 62305 |  |
| 3. | Cross-section area | mm2 |  |  |
| 4. | Thickness of lead-sheath | mm |  |  |
| 5. | Supports |  |  |  |
|  | Conductor supports of the lightning protection system |  |  |  |
|  | * Type |  |  |  |
| 6. | Earth rod |  |  |  |
|  | * Manufacturer |  |  |  |
|  | * Length | m |  |  |
|  | * Diameter | mm |  |  |
|  | * Material (copper, stainless steel) |  |  |  |
| 7 | Type test certificate (to be issued by independent laboratory or independently witnessed type test certificate available), to be attached to the offer | Yes/No | Yes |  |

# access control system

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1.0 | **Integrated Access Control System** | | | |
| 1.1 | Manufacturer and Country of Origin |  |  |  |
| 1.2 | Type  Manufacturers |  | Integrated Access Control System for Critical Utility Protection |  |
| 1.3 | Description |  | System with central management smart integration of:   * Perimeter Intrusion System on Fence, windows and doors * Access Control * Video surveillance * Fire systems |  |
| 1.4 | Video Management |  | Features:   * Crucial components continuous surveillance * Perimeter protection * Integrated intrusion detection, access control and visitor management * Video analytics also included |  |
| 1.5 | Access Control |  | Identity metrics supported:   * Contactless Smart Card * Pin Number * Biometric (Fingerprint)   Features:   * Facility customised map in GUI * Geospatial location mapping * Lock out and alarming including video snapshot of unauthorised access |  |
| 1.6 | Perimeter Intrusion Detection |  | Layered and integrated early warning detection and alarming systems:   * Video surveillance analytics * Motion detection * Intrusion alarming |  |
| 1.7 | Map based assessment |  | Map based reporting and tracking systems with geospatial “eyes on” visual display of intruders locations and potential alarm incidents. |  |

# CCTV

## CCTV (will have remote access to KETRACO HQ (KAWI HOUSE))

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Computer |  | Industrial |  |
| 2 | Mother board |  |  |  |
| 3 | CPU MHZ |  | Corei7 |  |
| 4 | Type of RAM |  | DDR3 |  |
| 5 | Size of RAMMB |  | 2x16GB |  |
| 6 | H.D.D  Type  Size  Size of buffer  Head size  Caption | GB  MB | SSD  512  2x120  (6Gb/S) |  |
| 7 | Display adapter |  | Yes |  |
| 8 | DVD ROM |  | Yes |  |
| 9 | DVD writer |  | Yes |  |
| 10 | Monitor |  | 2\*LCD 42" |  |
| 12 | Sound card |  | Yes |  |
| 13 | Power of case |  | Yes , industrial |  |
| 14 | Speaker |  | Yes |  |
| 15 | Keyboard |  | Yes |  |
| 16 | Mouse |  | Yes |  |
| 17 | F.D.D |  | yes |  |
| 18 | Operating system |  | The latest Microsoft Windows Operating system at the time of bid submission |  |

## CCTV - UPS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer`s name and country |  |  |  |
| 2 | Manufacturer`s type and designation |  |  |  |
| 3 | Output Voltage |  | 240V, AC |  |
| 4 | Power rating | KVA | 10 |  |
| 5 | Transfer time | Sec | 0 |  |
| 6 | Overload capability | % | 125 |  |
| 7 | Regulation |  | Yes |  |
| 8 | Input Voltage | V | 240 |  |
| 9 | Maximum current | A | 5 |  |
| 10 | Power factor |  | 0.9 |  |
| 11 | Battery | AH |  |  |
| 12 | Manufacturer`s name and country |  |  |  |
| 13 | Manufacturer`s type and designation |  |  |
| 14 | Rating |  |  |  |
| 15 | Number of cells |  |  |
| 16 | Autonomy time | H | 8 |  |
| 17 | Recharge time | H | 10 |  |
| 18 | Communication |  |  |  |
| 19 | User interface |  | RS232 |  |
| 20 | Networks |  | Yes |  |

## CCTV – Mobile Camera

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Horizontal resolution  in color mode  in B/W mode | lines  lines |  |  |
| 4 | Vertical resolution lines |  |  |  |
| 5 | Minimum illumination  in color mode  in B/W mode | Lx |  |  |
| 6 | Zoom speed | Sec |  |  |
| 7 | Focus speed | Sec |  |  |
| 8 | Video out put |  |  |  |
| 9 | Panning range | Degree |  |  |
| 10 | Tilting range | Degree |  |  |
| 11 | Iris |  |  |  |
| 2 | Alarm in |  |  |  |
| 13 | Alarm out |  |  |  |
| 14 | Ambient operating temperature | Degree C |  |  |
| 15 | Ambient operating humidity |  |  |  |
| 16 | Heater | W | Yes |  |
| 17 | Power of heater | W |  |  |
| 18 | Weight | kg |  |  |
| 19 | Number of camera’s  IP protection |  | IP66/67/Ethernet type |  |

## CCTV – Fixed Camera

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Horizontal resolution  in color mode  in B/W mode | lines  lines |  |  |
| 4 | Vertical resolution | lines |  |  |
| 5 | Minimum illumination  in color mode  in B/W mode | Lx |  |  |
| 6 | Signal to noise ratio | dB |  |  |
| 7 | Lens mount |  |  |  |
| 8 | Video out put |  |  |  |
| 9 | Electronic shutter |  |  |  |
| 10 | Alarm out |  | Yes |  |
| 11 | Ambient operating temperature | Degree C | -40˚C to +85˚C |  |
| 12 | Ambient operating humidity |  | max (year):100  min(year):20 |  |
| 13 | Heater |  | yes |  |
| 14 | Power of heater | W | 40 |  |
| 15 | Weight | kg |  |  |
| 16 | Number of camera’s IP protection |  | IP66/67-Ethernet type |  |

## CCTV – Lens

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Manufacturer’s model number |  |  |  |
| 4 | Focal length | mm |  |  |
| 5 | Aperture |  |  |  |
| 6 | Mount |  |  |  |
| 7 | Image format |  |  |  |
| 8 | Dimension |  |  |  |

## CCTV – Power cable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** | |
| 1 | General |  |  |  | |
| 2 | Manufacturer’s name and country |  |  |  | |
| 3 | Applicable technical standard |  |  |  | |
| 4 | Voltage rating | kV |  |  | |
| 5 | Conductor material |  |  |  | |
| 6 | Type of conductor (stranded or solid) |  |  |  | |
| 7 | Conductor insulation material |  |  |  | |
| 8 | Insulation resistance at 20oC | mΩ /Km |  |  | |
| 9 | Sheath material |  |  |  | |
| 10 | Composition of sheath: |  | Yes |  | |
| 11 | Composition of sheath:  a) Lead sheath  lead  Tin  Cadmium  Antimony  b) Other sheath | %  %  %  % | -40˚C to +85˚C |  | |
| 12 | Armouring material |  | Galvanized steel |  | |
| 13 | Number of layers of steel tapes |  | 2-tape |  | |
| 14 | Type of outer sheath and color |  | P.V.C/Black/Blue |  | |
| 15 | Minimum bending radius x (O.D.) |  | 12\*(O.D.) for multi-core & 15\*(O.D.) for single core |  | |
| 16 | Test voltage levels | kV | 3.5KVAC |  | |
|  |  |  | | Data offered |
|  |  |  | |  |
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## CCTV – POWER CABLE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Special for each type |  |  |  |
| 2 | Manufacture’s type and designation |  | NYRY |  |
| 3 | No. of cores and core cross section area | mm2 | At design stage |  |
| 4 | Normal current carrying capacity (in air), at 30 °C Ambient |  | At design stage |  |
| 5 | Thickness of core insulation | mm | ≥0.8 |  |
| 6 | Color code or numbering code of cores |  | At design stage |  |
| 7 | Thickness of sheath | mm | ≥1.8 |  |
| 8 | Minimum thickness of insulation between core and sheath | mm | ≥1.0 |  |
| 9 | Armoring thickness | mm |  |  |
| 10 | External diameter of completed cable | mm |  |  |
| 11 | Weight per meter of completed cable | Kg |  |  |
| 12 | Estimated length which will be provided per drum | m |  |  |
| 13 | Estimated length of cable to be supplied | m | As Req. |  |
| 14 | Max. current in inter shield (amors or shield) under line ground fault condition - A |  |  |  |
| 15 | Resistance of each core per km at 20°C | Ω |  |  |
| 16 | Mean electro - static capacitance of each conductor to earth per km of complete cable |  |  |  |
| 17 | Estimated length for control & protection cables | m | As Req. |  |

## CCTV – Data Cable/Ethernet cable

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | General |  | Should comply to outdoor STP ANSI/TIA 568C |  |
| 2 | Manufacturer’s name and country |  | Specified by bidder |  |
| 3 | Applicable technical standard |  | BS 6500(1990) similar to IEC (227) (53) |  |
| 4 | Voltage rating | kV | 0.3/0.5 |  |
| 5 | Conductor material |  | Cu |  |
| 6 | Type of conductor (stranded or solid) |  | stranded |  |
| 7 | Conductor insulation material |  | PVC |  |
| 8 | Insulation resistance at 20°C | mΩ /Km | 1000 |  |
| 9 | Sheath material |  | PVC |  |
| 10 | Composition of sheath: |  |  |  |
| 11 | 1. Lead sheath   Tin  Cadmium  Antimony | %  %  % |  |  |
| 12 | b) Other sheath |  |  |  |
| 13 | Armoring material |  |  |  |
| 14 | Number of layers of steel tapes |  |  |  |
| 15 | Type of outer sheath and color |  | PVC / White |  |
| 16 | Minimum bending radius x (O.D.) |  | 7xO.D ~ 7 Cm |  |
| 17 | Test voltage levels | kV |  |  |
| 18 | Special for each type |  |  |  |
| 19 | Manufacture’s type and designation |  |  |  |
| 20 | No. of cores and core cross section area | mm² |  |
| 21 | Normal current carrying capacity (in air), at 30 °C Ambient |  |  |  |
| 22 | Thickness of core insulation | mm |  |  |
| 23 | Color code or numbering code of cores |  | At design stage |  |
| 24 | Thickness of sheath | mm | Acc. To IEC… |  |
| 25 | Minimum thickness of insulation between core and sheath | mm | Acc. To IEC… |  |
| 26 | Armoring thickness | mm |  |  |
| 27 | External diameter of completed cable | mm |  |  |
| 28 | Weight per meter of completed cable | Kg |  |  |
| 29 | Estimated length which will be provided per drum | m |  |  |
| 30 | Estimated length of cable to be supplied | m |  |  |
| 31 | Max. current in inter shield (armors or shield) under line ground fault condition | A |  |  |
| 32 | Resistance of each core per km at 20 °C Ω | Ω |  |  |
| 33 | Mean electro - static capacitance of each conductor to earth per km of complete cable |  |  |  |
| 34 | Estimated length for control & protection cables | m | As Req. |  |

## CCTV – Housing

| **S.No.** | | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- | --- |
| 1 | | Manufacture’s name and country |  |  |  |
| 2 | | Type of fixture |  | Telescopic |  |
| 3 | | Fixture mounting height | m | 5 ~ 7 |  |
| 4 | | Number of fixtures |  | As Req. |  |
| 5 | | Minimum length of horizontal bracket |  | At design stage |  |
| 6 | | Type of bracket for movable camera |  | At design stage |  |
| 7 | | Heater | yes/no | in Housing |  |
| 8 | | Power of heater | W | 40 |  |
| 9 | | Manufacturer’s name and country |  |  |  |
| 10 | | Manufacturer’s type and designation |  |  |  |
| 11 | | Material of cabinet |  |  |  |
| 12 | | Material of glass |  | Nano Type |  |
| 13 | | Dimension  Length  Width  Hight | mm  mm  mm |  |  |
| 14 | | No. of housing for fixed camera |  | As Req. |  |
| 15 | | No. of housing for movable camera |  | As Req. |  |
|  | |  | |  |  |
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## CCTV – Controller

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Ambient operating temperature |  | +10°C-+40°C |  |
| 4 | Ambient operating humidity |  | 90% |  |
| 5 | Power Source AC/DC  Voltage  Current | AC/DC  V  mA | 230VAC-9VDC |  |
| 6 | Controller number |  | 4 |  |
| 7 | Camera number selection |  | ≥24 |  |
| 8 | All of lens functions |  | Yes |  |
| 9 | System operation |  |  |  |
| 10 | Pan/Tilt |  |  |  |
| 11 | Switching functions |  |  |  |
| 12 | Type of output data/input data |  | RS485-P.S-Data |  |
| 13 | Type of prot. for PC |  | Via matrix |  |
| 14 | Accessories |  |  |  |

## CCTV – Video Switchers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Type of camera inputs |  | 32 |  |
| 4 | Type of camera outputs |  | 1600% |  |
| 5 | Frequency response | MHz | >6 |  |
| 6 | Time of switching interval | Sec | Variable/as setup |  |
| 7 | Ext. time input |  | Yes |  |
| 8 | Ext. time output |  | Yes |  |
| 9 | Alarm input |  | Yes |  |
| 10 | Number of alarm input |  | ≥8 |  |
| 11 | Alarm buzzer |  | Yes |  |
| 12 | Power source |  | AC/22-230V |  |
| 13 | Three – position - lever switchers |  | Yes |  |

## CCTV – Multiplexer

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Picture in picture function |  | Yes |  |
| 4 | Picture out picture function |  | Yes |  |
| 5 | Zoom function |  | Yes |  |

## CCTV – DVR – TELE EYE

| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| --- | --- | --- | --- | --- |
| 1 | Manufacturer’s name and country |  |  |  |
| 2 | Manufacturer’s type and designation |  |  |  |
| 3 | Video input |  |  |  |
| 4 | Standard  Pal/CCIR, lines, field per second  NTSC/EIA, Lines, field per second |  |  |  |
| 5 | No. of channel | Nos | 32 |  |
| 6 | Resolution  In quality mode  in speed mode |  | Min:  25Im/sec 720x576 PAL  100Im/sec 360x288 PAL |  |
| 7 | Video output |  | Min: BNC out/ monitor out RGB/ S video/ RCA |  |
| 8 | Standard  One) Pal/CCIR, lines, field per second  Two) NTSC/EIA, Lines, field per second |  |  |  |
| 9 | No. of channels |  | Min: 2xBNC/ 1XRGB/ S video |  |
| 10 | Type of standalone operation |  | To be specified by Bidder |  |
| 11 | Communication |  | RS485/RS232/RS 985 ,RJ11 |  |
| 12 | Network |  | 10/100 RJ45 |  |
| 13 | Concurrent users |  | To be specified by Bidder |  |
| 14 | Web server |  | Yes |  |
| 15 | Sure link |  | Yes |  |
| 16 | Modem port |  | RS 45 |  |
| 17 | Port |  | RS 105 |  |
| 18 | Data bits |  | RS 232 |  |
| 19 | Stop bit |  | 100 mbps over Ethernet |  |
| 20 | Connection speed | kbps | 32 ~ unlimited |  |
| 21 | Parity | yes/no | Yes |  |
| 22 | Aux port |  |  |  |
| 23 | Recording |  |  |  |
| 24 | Mode |  |  |  |
| 25 | HD type |  |  |
| 26 | HD size |  |  |
| 27 | Max. recording rate | fps | Min: 100 fps per channel Depend on storage EXT.(To 7.5TB) |  |
| 28 | Event handling |  |  |  |
| 29 | Event type |  | To be specified by Bidder |  |
| 30 | Action type |  |  |
| 31 | External input |  |  |
| 32 | Relay switch |  |  |  |
| 33 | No. of channels |  | Min: 32CH=16CHx2 |  |
| 34 | Max. rating |  | To be specified by Bidder |  |
| 35 | Power |  |  |  |
| 36 | Voltage | V | 240VAC |  |
| 37 | Max. current | mA |  |  |
| 38 | Operating environment |  |  |  |
| 39 | Ambient temperature | °C | +10° to +40° |  |
| 40 | Relative humidity |  | Less than 90% |  |

## CCTV – Other Requirements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| .1 | Computer |  | Industrial |  |
| 2 | Mother board |  |  |  |
| 3 | CPU | MHz | Corei5 |  |
| 4 | Type of RAM |  | DDR3 |  |
| 5 | Size of RAM | MB | 4 GB |  |
| 6 | H.D.D  Type  Size  Size of buffer  Head size  Caption | GB  MB | SSD  2x60GB  120  3.5"  (8Gb/S) |  |
| 7 | Display adapter |  | Yes |  |
| 8 | DVD ROM |  | Yes |  |
| 9 | DVD writer |  | Yes |  |
| .10 | Monitor to beam the footages |  | 2\*LCD 42" |  |
| 11 | Sound card |  | Yes |  |
| 12 | Power of case |  | Yes , industrial |  |
| 13 | Speaker |  | Yes |  |
| 14 | Keyboard |  | Yes |  |
| 15 | Mouse |  | Yes |  |
| 16 | F.D.D |  | no |  |
| 17 | Operating system |  | To be specified by Bidder |  |

# HVAC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| **1.** | **MAIN HVAC CONTROL PANEL** |  |  |  |
|  | Manufacturer / country of origin |  | To be specified by Bidder |  |
|  | Model | % | 95% |  |
|  | Applicable standards | °C | -20 TO 50C |  |
|  | Enclosure color code | V | 220 VAC |  |
|  | HVAC CONTROL PANEL | V | 24VDC |  |
|  | Manufacturer / country of origin |  |  |  |
|  | Model (wall mounted) |  |  |  |
|  | Applicable standards |  |  |  |
|  | Enclosure color code |  |  |  |
| **2.** | **SPLIT UNITS** |  |  |  |
|  | Manufacturer / country of origin |  | Manufacturer / country of origin |  |
|  | Quantity |  | Quantity |  |
|  | Model |  | Model |  |
|  | Applicable standards |  | Applicable standards |  |
|  | Type |  | Type |  |
|  | Power | kW | Power |  |
|  | Condenser model |  | Condenser model |  |
|  | Manufacturer / country of origin |  | Manufacturer / country of origin |  |
| **3.** | **AIR COOLED CONDENSING UNITS** |  |  |  |
|  | Manufacturer / country of origin |  |  |  |
|  | Quantity |  |  |  |
|  | Model |  |  |  |
|  | Applicable standards |  |  |  |
|  | Type of refrigerant |  |  |  |
|  | Cooling capacity | kW/TR |  |  |
|  | Number of cooling circuit | No |  |  |
|  | Compressors per cooling circuit | No |  |  |
|  | Compressor model |  |  |  |
|  | Compressor type |  |  |  |
|  | Condenser coil |  |  |  |
|  | Fin material |  |  |  |
|  | Tube material |  |  |  |
| **4.** | **EXHAUST FANS** |  |  |  |
|  | Manufacturer / country of origin |  |  |  |
|  | Quantity |  |  |  |
|  | Model |  |  |  |
|  | International approvals |  |  |  |
|  | Fan Speed | rpm |  |  |
|  | Fan impeller material |  |  |  |
|  | Fan Shaft Material |  |  |  |
|  | Voltage/Frequency | V/Hz |  |  |
|  | Capacity for Battery room, toilet, pantry,  basement |  |  |  |
|  | Capacity for gas cylinder room, staircase  pressurization fans, diesel pump exhaust |  |  |  |
|  | Gas flooded room fan type |  |  |  |
|  | Type |  |  |  |
|  | Capacity |  |  |  |
|  | Basement extract fans |  |  |  |
|  | Battery room fan type |  |  |  |
|  | Storage warehouse |  |  |  |
|  | DG house |  |  |  |
| 5. | **EXHAUST AIR FLOW RATES** |  |  |  |
| 5.1 | Control Building |  |  |  |
|  | Telecommunication room | m3/s |  |  |
|  | Battery room | m3/s |  |  |
|  | Relay room | m3/s |  |  |
|  | LVAC/DC room | m3/s |  |  |
|  | Cable basement | m3/s |  |  |
|  | Operator room | m3/s |  |  |
|  | Office | m3/s |  |  |
|  | Kitchen or pantry | m3/s |  |  |
|  | Store | m3/s |  |  |
|  | Toilet | m3/s |  |  |
| 5.2 | Guard House and Telecom Room | m3/s |  |  |
|  | Main equipment room | m3/s |  |  |
|  | Customer equipment room | m3/s |  |  |
|  | Battery room | m3/s |  |  |
|  | Guard room | m3/s |  |  |
|  | Kitchen | m3/s |  |  |
|  | Toilet | m3/s |  |  |
| 5.3 | Staff Housings | m3/s |  |  |
| 5.3.1 | Technical staff housing | m3/s |  |  |
|  | Bedroom | m3/s |  |  |
|  | Living room | m3/s |  |  |
|  | Kitchen | m3/s |  |  |
|  | Toilet | m3/s |  |  |
| 5.3.2 | Security staff housing | m3/s |  |  |
|  | Bedroom | m3/s |  |  |
|  | Living room | m3/s |  |  |
|  | Kitchen | m3/s |  |  |
|  | Toilet | m3/s |  |  |
| 5.4 | DG house | m3/s |  |  |
| 5.5 | Fire pump house | m3/s |  |  |
| **6.** | **SOUND ATTENUATORS** |  |  |  |
| 6.1 | Manufacturer / country of origin |  |  |  |
| 6.2 | Model |  |  |  |
| 6.3 | International approvals |  |  |  |
| 6.4 | Main supply air |  |  |  |
| 6.5 | Main return air |  |  |  |
| 6.6 | Pressure drop across attenuators | Pa |  |  |
| 6.7 | Main supply air | Pa |  |  |
| 6.8 | Main return air | Pa |  |  |

# FIRE DETECTION ALARM SYSTEM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| **1.** | **FACP (FIRE ALARM CONTROL PANEL)** |  |  |  |
| 1.1 | Amb. Temp. Min / Max |  |  |  |
| 1.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 1.1 | Normal operation temperature | °C | -20 TO 50C |  |
| 1.3 | Input voltage | V | 220 VAC |  |
| 1.4 | Output voltage | V | 24VDC |  |
| 1.5 | Output current |  |  |  |
| 1.6 | Manufactured to which standard |  |  |  |
| 1.7 | Dimensions |  |  |  |
| 1.8 | Weight |  |  |  |
| 1.9 | Color |  |  |  |
| 1.10 | Fully programmable | Yes/No | Yes |  |
| 1.11 | Password protection | Yes/No | Yes |  |
| 1.12 | Event History | Yes/No | Yes |  |
| 1.13 | RS 232 / RS 485 | Yes/No | Yes |  |
| 1.14 | Isolation facility | Yes/No | Yes |  |
| 1.15 | Paging System interface | Yes/No | Yes |  |
| 1.16 | Network facility |  |  |  |
| 1.17 | Ingress protection |  | IP51 |  |
| 1.18 | Temperature rating | °C | MAX. 50C |  |
| 1.19 | Amb. Relative Hummidity Max. | % | 95% |  |
| 1.20 | Normal operation temperature | °C | -20 TO 50C |  |
| 1.21 | Input voltage | V | 220 VAC |  |
| 1.22 | Output voltage | V | 24VDC |  |
| 1.23 | Output current |  |  |  |
| 1.24 | Manufactured to which standard |  |  |  |
| 1.25 | Dimensions |  |  |  |
| 1.26 | Weight |  |  |  |
| 1.27 | Color |  |  |  |
| 1.28 | Fully programmable | Yes/No | Yes |  |
| 1.29 | Password protection | Yes/No | Yes |  |
| 1.30 | Event History | Yes/No | Yes |  |
| 1.31 | RS 232 / RS 485 | Yes/No | Yes |  |
| 1.32 | Isolation facility | Yes/No | Yes |  |
| 1.33 | Paging System interface | Yes/No | Yes |  |
| 1.34 | Network facility |  |  |  |
| 1.35 | Ingress protection |  | IP51 |  |
| 1.36 | Temperature rating | °C | MAX. 50C |  |
| 1.37 | MOUNTING |  | wall mounted |  |
| 1.38 | cable access |  | Bottom |  |
| 1.39 | Quantity | No. | According To Design |  |
| 1.40 | Other specifications |  |  |  |
| 1.41 | Loop number | No. | According To Design |  |
| 1.42 | Backup Battery | Yes/No | YES (According To NFPA) |  |
| 1.43 | DISPLAY |  | LCD |  |
| 1.44 | LED ZONE (INDICATOR) | Yes/No | Yes |  |
| 1.45 | Charger | Yes/No | Yes |  |
| 1.46 | Type | Addressable/ Conventional | Addressable |  |
| 1.47 | Certificate |  |  |  |
| 1.48 | Relay card |  |  |  |
| 1.49 | Model No. |  |  |  |
| 1.50 | Manufacturer |  |  |  |
| 1.51 | Requisition No. |  |  |  |
| 1.52 | P.O. No. |  |  |  |
| **2** | **FIX HEAT DETECTOR** |  |  |  |
| 2.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 2.2 | Ambient Relative Humidity Max. | % | 95% |  |
| 2.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 2.4 | Type and model | Addressable/Conventional | Addressable |  |
| 2.5 | Function |  | Heat Detector |  |
| 2.6 | Supply voltage | V | 17-28 v dc |  |
| 2.7 | Current at 24 Vdc |  |  |  |
| 2.8 | Alarm current at 24vdc |  |  |  |
| 2.9 | Humidity | % | 0-95% |  |
| 2.10 | Manufactured to which standard |  |  |  |
| 2.11 | Dimensions |  |  |  |
| 2.12 | Weight |  |  |  |
| 2.13 | Color |  | WHITE |  |
| 2.14 | Ingress protection |  |  |  |
| 2.15 | Sensibility range for |  | SENSITIVITY IS AUTOMATICALLY ADJUST |  |
| 2.16 | Alarm indicator | Color/type | Red LED |  |
| 2.17 | Grade |  | 1 |  |
| 2.18 | Response time | Low/Fast | Fast |  |
| 2.19 | Initiating temperature |  |  |  |
| 2.20 | Mounting |  | Base |  |
| 2.21 | Body & housing material |  |  |  |
| 2.22 | Output signal |  | Serial out put |  |
| 2.23 | Detector type |  | Ionization and Photoelectric |  |
| 2.24 | Material |  | Fire Retardant Plastic |  |
| 25 | Sensor Type |  | fixed temperature |  |
| 26 | Certificate |  |  |  |
| 27 | Model No. |  |  |  |
| 28 | Manufacturer |  |  |  |
| 29 | Requisition No. |  |  |  |
| 30 | P.O. No. |  |  |  |
| **3** | **RATE OF RISE HEAT DETECTOR** |  |  |  |
| 3.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 3.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 3.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 3.4 | Type and model | Addressable/Conventional | Addressable |  |
| 3.5 | Function |  | Heat Detector |  |
| 3.6 | Supply voltage | V | 17-28 v dc |  |
| 3.7 | Current at 24 Vdc |  |  |  |
| 3.8 | Alarm current at 24vdc |  |  |  |
| 3.9 | Humidity | % | 0-95% |  |
| 3.10 | Manufactured to which standard |  |  |  |
| 3.11 | Dimensions |  |  |  |
| 3.12 | Weight |  |  |  |
| 3.13 | Color |  | White |  |
| 3.14 | Ingress protection |  | IP53 |  |
| 3.15 | Sensibility range for |  | Sensitivity Is Automatically Adjust |  |
| 3.16 | Alarm indicator | Color/type | Red LED |  |
| 3.17 | Grade |  | 1 |  |
| 3.18 | Response time | TEMP.RISE ºc/min | 1, 3, 5, 10, 20, 30 |  |
| 3.19 | Initiating temperature |  |  |  |
| 3.20 | Mounting |  | Base |  |
| 3.21 | Body & housing material |  |  |  |
| 3.22 | Output signal |  | Serial out put |  |
| 3.23 | Detector type |  | Ionization and Photoelectric |  |
| 3.24 | Material |  | Fire Retardant Plastic |  |
| 3.25 | Sensor Type |  | Rate of rise |  |
| 3.26 | Certificate |  |  |  |
| 3.27 | Model No. |  |  |  |
| 3.28 | Manufacturer |  |  |  |
| 3.29 | Requisition No. |  |  |  |
| 3.30 | P.O. No. |  |  |  |
| **4** | **SMOKE DETECTOR** |  |  |  |
| 4.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 4.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 4.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 4.4 | Type and model | Addressable/ Conventional | Addressable |  |
| 4.5 | Supply voltage | V | 17-28 v dc |  |
| 4.6 | Current at 24 Vdc |  |  |  |
| 4.7 | Alarm current at 24vdc |  |  |  |
| 4.8 | Humidity | % | 0-95% |  |
| 4.9 | Manufactured to which standard |  |  |  |
| 4.10 | Dimensions |  |  |  |
| 4.11 | Weight |  | WHITE |  |
| 4.12 | Color |  |  |  |
| 4.13 | Ingress protection |  | IP43 |  |
| 4.14 | Sensibility range for |  | SENSITIVITY IS AUTOMATICALLY ADJUST |  |
| 4.15 | Alarm indicator | Color/type | Red LED |  |
| 4.16 | Response time | Low/Fast | FAST |  |
| 4.17 | Initiating temperature |  |  |  |
| 18 | Temperature rating | °C | MAX. 50C |  |
| 4.19 | Quantity (CON.-ADD.-EX.-ISO.) |  | ACCORDING TO DESIGN |  |
| 4.20 | Detector type |  | Ionization and Photoelectric |  |
| 4.21 | Material |  | Fire Retardant Plastic |  |
| 4.22 | Certificate |  |  |  |
| 4.23 | Model No. |  |  |  |
| 4.24 | Manufacturer |  |  |  |
| 4.25 | Requisition No. |  |  |  |
| 4.26 | P.O. No. |  |  |  |
| **5** | **BEAM DETECTOR** |  |  |  |
| 5.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 5.2 | Amb. Relative Humidity Max. | % | 0.95 |  |
| 5.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 5.4 | Type and model | Addressable/ Conventional | Addressable |  |
| 5.5 | Supply voltage | V | 17-28 v dc |  |
| 5.6 | Current at 24 vdc |  |  |  |
| 5.7 | Alarm current at 24vdc |  |  |  |
| 5.8 | Humidity | % | 0-95% |  |
| 5.9 | Manufactured to which standard |  |  |  |
| 5.10 | Dimensions |  |  |  |
| 5.11 | Weight |  |  |  |
| 5.12 | Color |  | WHITE |  |
| 5.13 | Ingress protection |  | IP53 (Indoor) , IP65 (Outdoor) |  |
| 5.14 | Diameter of infra-red | m | min:3m |  |
| 5.15 | Alarm indicator | Color/type | Red LED |  |
| 5.16 | maximum distance | m | 100 |  |
| 5.17 | Normal operation temperature | °C | -20 TO 60C |  |
| 5.18 | Quantity |  | ACCORDING TO DESIGN |  |
| 5.19 | Automatic Gain Control | Yes/No | Yes |  |
| 5.20 | Fault alarm indication | Yes/No | Yes |  |
| 5.21 | Material |  | Fire Retardant Plastic |  |
| 5.22 | Certificate |  |  |  |
| 5.23 | Model No. |  |  |  |
| 5.24 | Manufacturer |  |  |  |
| 5.25 | Requisition No. |  |  |  |
| 5.26 | P.O. No. |  |  |  |
| **6** | **LHD (LINEAR HEAT DETECTOR)** |  |  |  |
| 6.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 6.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 6.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 6.4 | Type and model | Addressable/ Conventional | Addressable |  |
| 6.5 | Supply voltage | V | 17-28 v dc |  |
| 6.6 | Current at 24 vdc |  |  |  |
| 6.7 | Maximum Ambient Install Temperature |  |  |  |
| 6.8 | Manufactured to which standard |  |  |  |
| 6.9 | Ingress protection |  | IP53 (Indoor) , IP65 (Outdoor) |  |
| 6.10 | Alarm Temp. | °C | 60-70c |  |
| 6.11 | Manufactured to which standard |  |  |  |
| 6.12 | Sheath |  | Advanced Polymer Thermal Reactant. twisted pair |  |
| 6.13 | Metallic Core |  | Tin For Corrosion Resistance. steel provides tensile strength copper increases conductivity |  |
| 6.14 | Outer Covering |  | Chemical and UV Resistant |  |
| 6.15 | Quantity |  | According To Design |  |
| 6.16 | Certificate |  |  |  |
| 6.17 | Model No. |  |  |  |
| 6.18 | Manufacturer |  |  |  |
| 6.19 | Requisition No. |  |  |  |
| 6.20 | P.O. No. |  |  |  |
| **7** | **GD (GAS DETECTOR)** |  |  |  |
| 7.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 7.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 7.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 7.4 | Type and model |  | Electro Chemical  (Domestic gas ) |  |
| 7.5 | Supply voltage | V | 17-28 v dc |  |
| 7.6 | Current at 24 Vdc |  |  |  |
| 7.7 | Sensor life |  |  |  |
| 7.8 | Humidity | % | 0-95% |  |
| 7.9 | Manufactured to which standard |  | proper type suitable for area classification |  |
| 7.10 | Weight |  |  |  |
| 7.11 | Dimensions |  |  |  |
| 7.12 | Color |  | WHITE |  |
| 7.13 | Manufactured to which standard |  |  |  |
| 7.14 | Ingress protection |  | IP55 |  |
| 7.15 | Body material |  | 316 stainless steel |  |
| 7.16 | Alarm indication | Yes/No | Yes |  |
| 7.17 | Set point adjustment | PPM | 0-50 PPM |  |
| 7.18 | Normal operation temperature | °C | -20 TO 60C |  |
| 7.19 | Quantity |  | According To Design |  |
| 7.20 | output signal | No. | 1 No SPDT,1Amp-24VDC |  |
| 7.21 | Material |  | Fire Retardant Plastic |  |
| 7.22 | Certificate |  |  |  |
| 7.23 | Model No. |  |  |  |
| 7.24 | Manufacturer |  |  |  |
| 7.25 | Requisition No. |  |  |  |
| 7.26 | P.O. No. |  |  |  |
| **8** | **H2 GAS DETECTOR** |  |  |  |
| 8.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 8.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 8.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 8.4 | Type and model |  | Electro Chemical (H2 Gas) |  |
| 8.5 | Supply voltage | V | 17-28 v dc |  |
| 8.6 | Alarm current at 24vdc |  |  |  |
| 8.7 | Current at 24 Vdc |  |  |  |
| 8.8 | Sensor life | Year | at least 3 years |  |
| 8.9 | Manufactured to which standard |  |  |  |
| 8.10 | Dimensions |  |  |  |
| 8.11 | Weight |  |  |  |
| 8.12 | Color |  | WHITE |  |
| 8.13 | Ingress protection |  | IP54 |  |
| 8.14 | Body material |  |  |  |
| 8.15 | Alarm indication | Yes/No | Yes |  |
| 8.16 | Set point adjustment | PPM | 0-50 PPM |  |
| 8.17 | Normal operation temperature | °C | -20 TO 60C |  |
| 8.18 | Quantity |  | According To Design |  |
| 8.19 | output signal |  | 1 No SPDT,1Amp-24VDC |  |
| 8.20 | Material |  | Fire Retardant Plastic |  |
| 8.21 | Certificate |  |  |  |
| 8.22 | Area Classification |  | Explosion proof |  |
| 8.23 | Model No. |  |  |  |
| 8.24 | Manufacturer |  |  |  |
| 8.25 | Requisition No. |  |  |  |
| 8.26 | P.O. No. |  |  |  |
| **9** | **BEACONE** |  |  |  |
| 9.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 9.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 9.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 9.4 | Type and model | Addressable/Conventional | Addressable |  |
| 9.5 | Current at 24 Vdc |  |  |  |
| 9.6 | Alarm current at 24vdc |  |  |  |
| 9.7 | Nominal voltage |  |  |  |
| 9.8 | Manufactured to which standard |  |  |  |
| 9.9 | Dimensions |  |  |  |
| 9.10 | Color |  | Red |  |
| 9.11 | Weight |  |  |  |
| 9.12 | Ingress protection |  | IP53 (Indoor) , IP65 (Outdoor) |  |
| 9.13 | Temperature rating | °C | -25 TO 55C |  |
| 9.14 | Flash rate |  |  |  |
| 9.15 | Quantity |  | According To Design |  |
| 9.16 | Response time |  | Immediate Response |  |
| 9.17 | MOUNTING |  | Wall Mounted |  |
| 9.18 | Nominal voltage | V | 6-25VDC |  |
| 9.19 | Initiating temperature |  |  |  |
| 9.20 | Material |  | Fire Retardant Plastic |  |
| 9.21 | Certificate |  |  |  |
| 21.9.22 | Model No. |  |  |  |
| 21.9.23 | Manufacturer |  |  |  |
| 9.24 | Requisition No. |  |  |  |
| 9.25 | P.O. No. |  |  |  |
| **10** | **SOUNDER** |  |  |  |
| 10.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 10.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 10.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 10.4 | Type and model | Addressable/Conventional | Addressable |  |
| 10.5 | Nominal voltage |  |  |  |
| 10.6 | Current at 24 Vdc |  |  |  |
| 10.7 | Alarm current at 24vdc |  |  |  |
| 10.8 | Manufactured to which standard |  |  |  |
| 10.9 | Adjustable Volume Control | Yes/No | Yes |  |
| 10.10 | Dimensions |  |  |  |
| 10.11 | Weight |  |  |  |
| 10.12 | Ingress protection |  | IP53 (Indoor) , IP65 (Outdoor) |  |
| 10.13 | Temperature rating | °C | -25 TO 55C |  |
| 10.14 | Flash rate |  |  |  |
| 10.15 | Quantity |  | According To Design |  |
| 10.16 | Response time |  | Immediate Response |  |
| 10.17 | Nominal voltage | V | 6-25VDC |  |
| 10.18 | Initiating temperature |  | Wall Mounted |  |
| 10.19 | MOUNTING |  |  |  |
| 10.20 | SOUND LEVEL |  | 105 db (with volume control) |  |
| 10.21 | Material |  |  |  |
| 10.22 | Certificate |  |  |  |
| 10.23 | Model No. |  |  |  |
| 10.24 | Manufacturer |  |  |  |
| 10.25 | Requisition No. |  |  |  |
| 10.26 | P.O. No. |  |  |  |
| **11** | **POWER SUPPLY** |  |  |  |
| 11.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 11.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 11.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 11.4 | Input voltage | V | 220 VAC |  |
| 11.5 | Output voltage | V | 24VDC |  |
| 11.6 | Output current |  |  |  |
| 11.7 | Manufactured to which standard |  |  |  |
| 11.8 | Dimensions |  |  |  |
| 21.11.9 | Weight |  |  |  |
| 11.10 | Color |  |  |  |
| 11.11 | Ingress protection |  | IP42 |  |
| 11.12 | Temperature rating | °C | MAX. 50C |  |
| 11.13 | Quantity |  | According To Design |  |
| 11.14 | Other specifications |  |  |  |
| 11.15 | Backup Battery |  | Yes (According To NFPA) |  |
| 11.16 | Quantity |  | According To Design |  |
| 11.17 | Other specifications |  | For Details Refer To Detail Design |  |
| 11.18 | LED (INDICATOR) | Yes/No | Yes |  |
| 11.19 | Charger | Yes/No | Yes |  |
| 11.20 | Certificate |  |  |  |
| 11.21 | Model No. |  |  |  |
| 11.22 | Manufacturer |  |  |  |
| 11.23 | Requisition No. |  |  |  |
| 11.24 | P.O. No. |  |  |  |
| **12** | **CALL POINT** |  |  |  |
| 12.1 | Amb. Temp. Min / Max | °C | -16 TO 45.6 |  |
| 12.2 | Amb. Relative Humidity Max. | % | 95% |  |
| 12.3 | Normal operation temperature | °C | -20 TO 50C |  |
| 12.4 | Type and model | Addressable/Conventional | Addressable |  |
| 12.5 | Nominal voltage | V | 15-28VDC |  |
| .12.6 | Current at 24 Vdc |  |  |  |
| 12.7 | Alarm current at 24vdc |  |  |  |
| 12.8 | Manufactured to which standard |  |  |  |
| 12.9 | Dimensions |  |  |  |
| 12.10 | Weight |  |  |  |
| 12.11 | color |  | Red |  |
| 12.12 | Ingress protection |  | IP53 (Indoor) , IP65 (Outdoor) |  |
| 12.13 | Temperature | °C | -10 To 50c |  |
| 12.14 | Quantity |  | According To Design |  |
| 12.15 | Other specifications |  | Fast Response Operation In Two Wires On Line Test Facility - Break Glass |  |
| 12.16 | Mounting |  | Wall Mounted |  |
| 12.17 | LED indicator | Yes/No | Yes |  |
| 12.18 | Material |  | Fire Retardant Plastic |  |
| 12.19 | Breaking glass type | Yes/No | Yes |  |
| 12.20 | Certificate |  |  |  |
| 12.21 | Model No. |  |  |  |
| 12.22 | Manufacturer |  |  |  |
| 12.23 | Requisition No. |  |  |  |
| 12.24 | P.O. No. |  |  |  |

# SOLAR COLLECTOR TECHNICAL DETAILS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Type |  | Flat Plate Collector/Evacuated tube |  |
| 2 | Material |  | Copper-Copper |  |
| 3 | Size |  |  |  |
| 4 | Absorber Area |  |  |  |
| 5 | Type of welding |  | Ultrasonic welding. |  |
| 6 | Absorber coating |  | Selectively –NALSUN coated  (Black Chromium with Nickel undercoat  Copper (Grade DHP, as per IS:191) |  |
| 7 | Frame material      Material:  Channel Box  Bottom Sheet  Finish |  | Extruded Al sections. Welded Channel Box with top cover. Material –Al (Gr.63400) tempered to HE9 (WP)... Top joints sealed with UV resistant EPDM/silastic sealant & bottom sealed  Specify  Specify  STUCCO embossed, specify thickness  electrostatic powder coating finish |  |
| 8 | Riser |  |  |  |
| 9 | Material |  | Copper |  |
| 10 | Diameter |  |  |  |
| 11 | Thickness |  |  |  |
| 12 | Header |  |  |  |
| 13 | Material |  | Copper |  |
| 14 | Diameter |  |  |  |
| 15 | Thickness |  |  |  |
| 16 | Absorptivity |  | >0.95 |  |
| 17 | Emissivity |  | <0.15 |  |
| 18 | Front Glazing |  | Toughened Solar Glass with high solar transmittance |  |
| 19 | Thickness |  | 4mm |  |
| 20 | Frame |  | Extruded Pure Aluminum Angle |  |
| 21 | Size |  |  |  |
| 22 | Hardware |  |  |  |
| 23 | Grommet |  | Neoprene Rubber |  |
| 24 | Glass beading |  | EPDM |  |
| 25 | Insulation |  | Rockwool, 50 mm. Thick minimum |  |
| 26 | Density, minimum |  | 48Kg./cum |  |
| 27 | Cladding |  | Aluminum foil |  |
| 28 | Finish spray painting |  | BHEL standard color Powder COATED |  |
| 29 | Header & Outlet Joints |  | Copper Flange |  |
| 22.30 | Class Pipes |  | Class B |  |
| .31 | Pipe Insulation` |  | DENSITY: 60.10 KG / M3  Minimum Thermal Conductivity: 0.034 W/Mk at 200 C  -600 C to 1050 C |  |
| 32 | Solar Panel Make |  |  |  |
| 33 | Required Test Certificates |  | Shall be provided as desired in the tender for following items.  Insulator: density and thermal conductivity.  Solar Panel – Absorptivity and Emissivity. |  |
| 34 | Overhead cold water tank |  | 5000 LPD – with support structure to a height of 10 ft |  |
| 35 | Supply & installation of hot water pipe |  | B Class. Indicate dimensions |  |
| 36 | Supply & installation of cold water pipe |  | B class. Indicate dimensions |  |
| 37 | Standards accessories for non-domestic solar water heaters |  | Gate B class valve |  |
| 22.38 |  |  | Air relief value |  |
| 39 |  |  | Temperature gauge |  |
| 40 |  |  | Water meter |  |
| 41 |  |  | Non return valves |  |
| 42 |  |  | Drain cock |  |

## SOLAR WATER HEATING

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Description** | **UNIT** | **Data Required** | **Data Offered** |
| 1 | Number of solar flat plate collectors required |  |  |  |
| .2 | Collector Type |  | Copper with Chrome Coated |  |
| 3 | Collector dimensions (per collector) |  |  |  |
| 4 | Total Space required for the Collector |  |  |  |
| 5 | Space required for hot water insulated Tank |  |  |  |
| 6 | Collector weight (per collector) |  |  |  |
| 7 | Total Collector Weight for the System |  |  |  |
| 8 | Solar insulated hot water tank capacity | LPD | 300 |  |
| 9 | Minimum temperature of heated water | °C | 75 |  |
| 10 | Type of hot water storage tank |  | Graded Stainless Steel |  |
| 11 | Electrical Back-up | KW |  |  |

# TECHNICAL DATA SCHEDULES - OVERHEAD LINE LILO

## 400kV OHL

| **S. No.** | **Description** | **Unit** | **Required** | **Offered** |
| --- | --- | --- | --- | --- |
| **1.0** | **Minimum factors of safety to be applied to assumed maximum simultaneous maximum loadings** |  |  |  |
| **1.1** | **Line and earth conductors, based on ultimate strength** |  | 2.5 |  |
| **1.2** | **Line and earth conductors at everyday temperature, still air, based on ultimate strength** |  | 5 |  |
| **1.3** | **Complete insulators and fittings, based on SML** |  | 2.2 |  |
| **1.4** | **Steel supports, foundation structures, based on elastic limit of members in tension and on crippling loads of compression members, or on tests on complete supports (but not tests on the foundations):** |  |  |  |
| 1.4.1 | Suspension supports |  |  |  |
|  | 1. Normal conditions |  | 2.0 |  |
|  | 1. Unbalanced conditions (except cascade) 2. Cascade collapse condition |  | 1.5  1.0 |  |
| 1.4.2 | Tension supports |  |  |  |
|  | 1. Normal conditions |  | 2.0 |  |
|  | 1. Unbalanced conditions |  | 1.5 |  |
| 1.4.3 | Foundations |  |  |  |
|  | 1. Normal conditions |  | 2.5 |  |
| 1.4.4 | Maintenance and Erection |  | 2.0 |  |
| **2.0** | **ASSUMED LOADING CONDITIONS** |  |  |  |
| 2.1 | Minimum temperature of line and earth conductors | °C | 1 |  |
| 2.2 | “Everyday” temperature | °C | 25 |  |
| 2.3 | Maximum operating temperature of line conductor | °C | 80 |  |
| 2.4 | Basic Wind pressure (140km/h zone)  - Wind pressure on projected area of insulators  - Wind pressure on projected area of conductors  - Wind pressure on projected area of earth wires  - Wind pressure on the projected area of members of one face of the towers | N/m²  N/m²  N/m²  N/m²  N/m² | 950  1140  760  912  2660 |  |
| 2.5 | Site altitude above sea level (maximum) | metres | 900-1100 |  |
| **3.0** | **SPAN LENGTHS** |  |  |  |
| 3.1 | Basic span | m | 400 |  |
| 3.2 | Maximum sum of adjacent spans | m | 880 |  |
| 3.3 | Maximum single span | m | 600 |  |
| 3.4 | Tower design spans: |  |  |  |
| 3.4.1 | Wind span |  |  |  |
|  | 1. Suspension towers | m | 440 |  |
|  | 1. Tension towers | m | 450 |  |
| 3.4.2 | Maximum weight spans: |  |  |  |
|  | 1. Suspension towers | m | 800 |  |
|  | 1. Tension towers | m | 900 |  |
| 3.4.3 | Minimum weight spans (for design purposes): |  |  |  |
|  | 1. Suspension towers 2. Tension towers (uplift net) | m  m | 35% of sum of adjacent spans  450 |  |
| **4.0** | **LINE CONDUCTOR AND FITTINGS** |  | ACSR |  |
| 4.1 | Complete line conductor: |  |  |  |
| 4.1.1 | Nominal area per phase | mm2 | 990 |  |
| 4.1.2 | Number of conductors per phase | No | 4 |  |
| 4.1.3 | Distance between conductor centres of one phase | mm | 400 |  |
| 4.2 | Each single conductor: |  |  |  |
| 4.2.1 | Code name |  | Lark |  |
| 4.2.2 | International Standard |  | IEC 61089 |  |
| 4.2.3 | National standard |  | ASTM B 232 |  |
| 4.2.4 | Material of conductor |  | Aluminium/ Galvanised Steel |  |
| 4.2.5 | Number and diameter of wires | No/mm | Al 30/2.92  St 7/2.92 |  |
| 4.2.6 | Total area of conductor | mm2 | 247.8 |  |
| 4.2.7 | Overall diameter of stranded conductor | mm | 20.44 |  |
| 4.2.8 | Resistance of conductor (dc) at 20˚C | ohm/km | 0.1441 |  |
| 4.2.9 | Mass of conductor (without grease) | kg/km | 925 |  |
| 4.2.10 | Total mass of greased conductor (greased to Case 2 of IEC 61089) | kg/km |  |  |
| 4.2.11 | Ultimate rated strength of conductor | Newton | 90,250 |  |
| 4.2.12 | Maximum tension of conductor in still air at “everyday” temperature | Newton | 18,050 |  |
| 4.2.13 | Assumed equivalent modulus of elasticity of conductor | N/mm2 | 80,420 |  |
| 4.2.14 | Assumed equivalent coefficient of linear expansion of conductor | per ˚C | 1.78 x 10-5 |  |
| 4.2.15 | Maximum length of conductor on drum | km | 5 |  |
| 4.3 | Conductor grease: |  |  |  |
| 4.3.1 | Type |  |  |  |
| 4.3.2 | Minimum drop-point temperature | ˚C | 120 |  |
| 4.3.3 | Mass of grease per kilometre of conductor (all inner layers greased – Case 2 to IEC 61089) | kg |  |  |
| 4.4 | Vibration damping system: |  |  |  |
| 4.4.1 | Type of system (vibration damper + spacer or spacer damper) | type |  |  |
| 4.4.2 | Vibration damper (if proposed) |  |  |  |
| 4.4.2.1 | Type of vibration damper | type | Stockbridge |  |
| 4.4.2.2 | National / International standard |  | IEC 61897 |  |
| 4.4.2.3 | Number of wires in messenger cable | No | 19 |  |
| 4.4.2.4 | Conductor diameter range | mm | 20.44 |  |
| 4.4.2.5 | Mass of damper | kg |  |  |
| 4.4.2.6 | Maximum span for: |  |  |  |
|  | a.One vibration damper at each end of span | m |  |  |
|  | b.Two vibration dampers at each end of span | m |  |  |
|  | c.Three vibration dampers at each end of span | m |  |  |
| 4.4.2.7 | Dimensions from clamp mouth to vibration damper attachment: |  |  |  |
|  | a.First damper | mm |  |  |
|  | b.Second damper when required | mm |  |  |
|  | c.Third damper when required | mm |  |  |
| 4.4.3 | Spacer or spacer damper |  |  |  |
| 4.4.3.1 | Type of spacer or spacer damper |  |  |  |
| 4.4.3.2 | National / International standard |  | IEC 61854 |  |
| 4.4.3.3 | Conductor diameter range | mm | 20.44 |  |
| 4.4.3.4 | Mass | kg |  |  |
| 4.4.3.5 | Symmetrical / asymmetrical in-span spacing |  |  |  |
| 4.4.3.6 | Maximum sub-span length | m |  |  |
| **5.0** | **EARTH CONDUCTOR AND FITTINGS** |  | Aluminium  Clad Steel  GW | |
| 5.1 | Complete earth conductor system |  |  |  |
| 5.1.1 | Number of ACS earth conductors | No | 1 |  |
| 5.2 | Each single earth conductor |  |  |  |
| 5.2.1 | International Standard No |  | ASTM B416 |  |
| 5.2.2 | Material of conductor |  | Aluminium clad steel |  |
| 5.2.3 | Number and diameter of wires | No/mm | 7/3.26 |  |
| 5.2.4 | Total area of conductor | mm2 | 58.6 |  |
| 5.2.5 | Overall diameter of conductor | mm | 9.78 |  |
| 5.2.6 | Mass of conductor | kg/km | 390 |  |
| 5.2.7 | Ultimate strength of conductor | Newton | 71,000 |  |
| 5.2.8 | Maximum tension of conductor in still air at “everyday” temperature | Newton |  |  |
| 5.2.9 | Assumed equivalent modulus of elasticity of conductor | N/mm2 | 162,000 |  |
| 5.2.10 | Assumed equivalent coefficient of linear expansion of conductor | per °C | 12.96 x 10-6 |  |
| 5.2.11 | Minimum bending radius | mm |  |  |
| 5.2.12 | Minimum length of conductor on drum | km | 4 |  |
| 5.3 | Individual wires before stranding |  |  |  |
| 5.3.1 | Aluminium-clad steel |  | ASTM B415 |  |
|  | 1. Grade of steel |  | 20SA |  |
| 5.4 | Vibration damping system |  |  |  |
| 5.4.1 | Maximum span for: |  |  |  |
|  | a. One vibration damper at each end of span | m |  |  |
|  | b. Two vibration dampers at each end of span | m |  |  |
|  | c. Three vibration dampers at each end of span | m |  |  |
| **6.0** | **EARTH CONDUCTOR AND FITTINGS** |  | OPGW |  |
| 6.1 | Complete optical earth conductor system |  |  |  |
| 6.1.1 | Number of OPGW earth conductors | No | 1 |  |
| 6.2 | Each single optical earth conductor (OPGW) |  |  |  |
| 6.2.1 | International Standard No |  | IEE 1138  IEC 60794-4-1 |  |
| 6.2.2 | Material of conductor |  | Aluminium Alloy/  Aluminium-clad steel |  |
| 6.2.3 | Number and diameter of wire | No/mm |  |  |
| 6.2.4 | Total area of conductor | mm2 |  |  |
| 6.2.5 | Overall diameter of conductor | mm |  |  |
| 6.2.6 | Mass of conductor | kg/km | <850 |  |
| 6.2.7 | Ultimate strength of conductor | Newton | ≥ 93,000 |  |
| 6.2.8 | Maximum tension of conductor in still air at “everyday” temperature | Newton | > 18,500 |  |
| 6.2.9 | Assumed equivalent modulus of elasticity of conductor | N/mm2 | ≥ 70,000 |  |
| 6.2.10 | Assumed equivalent coefficient of linear expansion of conductor | per °C | ≤1.98 x 10-5 |  |
| 6.2.11 | Minimum bending radius | mm |  |  |
| 6.2.12 | Short circuit current rating | kA2s | 496 |  |
| 6.2.13 | Minimum length of conductor on drum | km | 4 |  |
| 6.3 | 1. Individual wires before stranding |  |  |  |
| 6.3.1 | Aluminium alloy Standard |  | IEC 60104 |  |
|  | Minimum conductivity at 20ºC | %IACS | 52.5 |  |
| 6.3.2 | Aluminium-clad steel Standard |  | IEC 60232 |  |
|  | Grade of Steel |  | 20SA |  |
| 6.4 | 1. Vibration damping system |  |  |  |
| 6.4.1 | Maximum span for: |  |  |  |
|  | 1. One vibration damper at each end of span | m |  |  |
|  | 1. Two vibration dampers at each end of span | m |  |  |
|  | 1. Three vibration dampers at each end of span | m |  |  |
| **7.0** | **OPTICAL FIBER GROUND WIRE** |  |  |  |
| 7.1 | Fibre optic data |  |  |  |
| 7.1.1 | Type |  | Non-Zero Dispersion-Shifted Single-Mode acc. to ITU G.655. |  |
| 7.1.2 | Wavelength | nm | 1550/1625 |  |
| 7.1.3 | Number of fibres |  | 48 |  |
| 7.1.4 | Transmission attenuation: |  |  |  |
|  | 1. at 1550 nm | dB/km | < 0.22 |  |
|  | 1. at 1625 nm | dB/km | < 0.24 |  |
| 7.1.5 | Transmission bandwidth | MHz/km | > 10 000 |  |
| 7.1.6 | Fibre identification | color code |  |  |
| 7.1.7 | Chromatic dispersion |  |  |  |
|  | 1. at 1550 nm | ps/nm.km | < 2 |  |
|  | 1. at 1625 nm | ps/nm.km | < 12.4 |  |
| 7.1.8 | Splicing loss | dB | < 0.1 |  |
| 7.1.9 | Polarisation Mode Dispersion (PMD) | ps/√km | < 20 |  |
| 7.1.10 | Minimum bending radius |  |  |  |
| **8.0** | **INSULATOR AND FITTINGS** |  |  |  |
| 8.1 | Insulator units: Long Rod |  |  |  |
| 8.1.1 | Suspension units |  |  |  |
| 8.1.1.1 | Shed profile |  | aerodynamic |  |
| 8.1.1.2 | Appropriate IEC Number |  | IEC 61109 |  |
| 8.1.1.3 | Material |  | Silicone rubber |  |
| 8.1.1.4 | Coupling   1. Standard 2. Type (recommended only) 3. Size (recommended only) |  | IEC 61120  Ball/Socket  20 |  |
| 8.1.1.5 | Minimum failing load | kN | 120 |  |
| 8.1.1.6 | Outside diameter: | mm |  |  |
| 8.1.1.7 | Mass of unit | kg |  |  |
| 8.1.1.8 | Minimum dry lightning impulse withstand | kV |  |  |
| 8.1.1.9 | Minimum wet power frequency withstands | kV |  |  |
| 8.1.1.10 | Creepage distance | mm | 13020 min. |  |
| 8.1.2 | Tension units |  |  |  |
| 8.1.2.1 | Shed profile |  | aerodynamic |  |
| 8.1.2.2 | Appropriate IEC Number |  | IEC 61109 |  |
| 8.1.2.3 | Material |  | Silicone rubber |  |
| 8.1.2.4 | Coupling   1. Standard 2. Type (recommended only) 3. Size (recommended only) |  | IEC 61120  Ball/Socket  20 |  |
| 8.1.2.5 | Minimum failing load | kN | 160 |  |
| 8.1.2.6 | Outside diameter: |  |  |  |
| 8.1.2.7 | Mass of unit | kg |  |  |
| 8.1.2.8 | Minimum dry lightning impulse withstand | kV |  |  |
| 8.1.2.9 | Minimum wet power frequency withstands | kV |  |  |
| 8.1.2.10 | Creepage distance | mm | 13020 min |  |
| 8.2 | Insulator sets complete |  |  |  |
| 8.2.1 | Suspension sets |  |  |  |
| 8.2.1.1 | Number of insulator strings in parallel |  | 2 |  |
| 8.2.1.2 | Minimum failing load, complete set | kN | 2\*120 |  |
| 8.2.1.3 | Overall length of set including clamps and all fittings | mm | ≤ 5150 |  |
| 8.2.1.4 | Arcing Gap | mm | 2900 |  |
| 8.2.1.5 | Mass of set, complete with all fittings | kg |  |  |
| 8.2.1.6 | Overall length of creepage path per string: | mm | 13020 min. |  |
| 8.2.1.7 | 50 Hz voltage tests: [[1]](#footnote-1)# |  |  |  |
|  | 1. Dry withstand voltage of complete set: | kV | 845 |  |
|  | 1. One minute wet withstand voltage of complete set: | kV | 680 |  |
| 8.2.1.8 | 50% Impulse withstand: # |  |  |  |
|  | 1. 1.2/50 μs negative wave: | kV | 1550 |  |
|  | 1. 1.2/50 μs positive wave: | kV | 1550 |  |
| 8.2.1.9 | Corona test voltage | kV | 290 |  |
| 8.2.1.10 | Set RI test voltage | kV | 275 |  |
| 8.2.1.11 | Set radio noise level | dB | 45 |  |
| 8.2.2.12 | Short circuit current withstands for 1 second (any part of set) | kA | 31.5 |  |
| 8.2.2 | Tension sets |  |  |  |
| 8.2.2.1 | 1. Number of insulator strings in parallel |  | 2 |  |
| 8.2.2.2 | 1. Elastic limit load of set fittings: |  |  |  |
|  | 1. Common to each string | kN |  |  |
|  | 1. Common to conductor | kN |  |  |
|  | 1. Separate for each sub-conductor | kN |  |  |
| 8.2.2.3 | Minimum failing load, complete set | kN | 320 |  |
| 8.2.2.4 | Overall length of set including clamps and all fittings | mm |  |  |
| 8.2.2.5 | Arcing Gap | mm | 2900 |  |
| 8.2.2.6 | Mass of set, complete with all fittings | kg |  |  |
| 8.2.2.7 | Overall length of creepage path per string: | mm | 16000 |  |
| 8.2.2.8 | 50 Hz voltage tests: [[2]](#footnote-2)# |  |  |  |
|  | 1. Dry withstand voltage of complete set: | kV | 548 |  |
|  | 1. One minute wet withstand voltage of complete set: | kV | 690 |  |
| 8.2.2.9 | 50% Impulse withstand: [[3]](#footnote-3)# |  |  |  |
|  | 1. 1.2/50 μs negative wave: | kV | 1550 |  |
|  | 1. 1.2/50 μs positive wave: | kV | 1550 |  |
| 8.2.2.10 | Corona test voltage | kV | 290 |  |
| 8.2.2.11 | Set RI test voltage | kV | 275 |  |
| 8.2.2.12 | Set radio noise level | dB | 45 |  |
| 8.2.2.13 | Short circuit current withstands for 1 second (any part of set) | kA | 31.5 |  |
| 8.3 | Earth conductor sets |  |  |  |
| 8.3.1 | Minimum failing load |  |  |  |
|  | 1. Suspension set | kN |  |  |
|  | 1. Tension set | kN |  |  |
| 8.3.2 | Short circuit current withstands for 1 second (any part of set) | kA | 31.5 |  |
| **9.0** | **TOWER DESIGN PARTICULARS** |  |  |  |
| 9.1 | Maximum tension per phase, for purposes of tower design |  |  |  |
|  | a.Suspension towers | Newton |  |  |
|  | b.Tension towers | Newton |  |  |
|  | c.Downleads per conductor bundle | Newton |  |  |
| 9.1.1 | Maximum tension per earth conductor for purpose of tower design and application: ACS Earth wire |  |  | |
|  | a.Suspension towers | Newton |  |  |
|  | b.Tension towers | Newton |  |  |
|  | c.Earth conductor downleads | Newton |  |  |
| 9.1.2 | Maximum tension per earth conductor for purpose of tower design and application: OPGW |  |  |  |
|  | a.Suspension towers | Newton |  |  |
|  | b.Tension towers | Newton |  |  |
|  | c.OPGW downleads | Newton |  |  |
| 9.2 | Minimum clearance between live metal and tower steelwork: - |  |  |  |
|  | a.with suspension insulator set swing, at 65º | mm | 1100 |  |
|  | b.with suspension insulator set swing, 0 - 10º | mm | 3100 |  |
|  | c.with suspension insulator set swing 10 - 35º | mm | 1800 |  |
| 9.3 | Minimum clearance to steelwork on which a man may stand for live line maintenance (crossarm floor) | m | 5.0 |  |
| 9.4 | Downleads – minimum clearances: |  |  |  |
|  | 1. phase to phase clearance in still air | mm | 4900 |  |
|  | 1. phase to phase clearance under conditions of maximum (opposing) swing and sag | mm | 3700 |  |
| 9.5 | Earth conductor suspension clamps, unobstructed transverse swing angle from vertical | degrees | 0 – 50 |  |
| 9.6 | Earth conductor maximum shielding angle from vertical at tower attachment point over outer line conductors | degrees | 17 |  |
| 9.7 | Maximum ratio of unsupported length of steel compression member to their least radius of gyration: |  |  |  |
|  | a.Main members |  | 120 |  |
|  | b.Stressed bracings |  | 200 |  |
|  | c.Unstressed bracings |  | 250 |  |
|  | d.Tension only members, detailed with draw |  | 500 |  |
| 9.8 | Maximum ultimate stresses, for checking tower designs not subjected to test (unless otherwise approved): - |  |  |  |
| 9.8.1 | Mild Steel: |  |  |  |
|  | a.Compression members, Tenderer to indicate his design assumptions |  | ASCE 10-97 |  |
|  | b.Tension members (elastic limit) | N/mm2 | 220 |  |
|  | c.Shear on bolts Bolt Grade 5.6 | N/mm2 |  |  |
|  | d.Material Bearing | N/mm2 |  |  |
| 9.8.2 | High Yield Steel: |  |  |  |
|  | a. Compression members, Tenderer to indicate his design assumptions |  | ASCE 10-97 |  |
|  | b. Tension members (elastic limit) | N/mm2 | 325 |  |
|  | c. Shear on bolts Bolt Grade 8.8 | N/mm2 |  |  |
|  | d. Material Bearing | N/mm2 |  |  |
| **10.0** | **SIMULTANEOUS UNBALANCED LOADING CONDITIONS – LONGITUDINAL LOADS**  **Factors of safety to be applied: see the Technical Parameters.**  **For transverse and vertical loads: see Appendix B of the Technical Specification.** |  |  |  |
| 10.1 | Straight line towers (suspension insulators) |  |  |  |
| 10.1.1 | At any one attachment: |  |  |  |
|  | a. phase or | Newton |  |  |
|  | b. earth | Newton |  |  |
| 10.1.2 | Cascade collapse conditions at all attachments: |  |  |  |
|  | a. phase | Newton |  |  |
|  | b. earth | Newton |  |  |
| 10.2 | Angle towers (tension insulators) |  |  |  |
| 10.2.1 | At any two attachments: |  |  |  |
|  | a. either phase or | Newton |  |  |
|  | b. earth | Newton |  |  |
| 10.2.2 | Cascade collapse conditions at all attachments: |  |  |  |
|  | a. phase | Newton |  |  |
|  | b. earth | Newton |  |  |
| 10.3 | Terminal towers (tension insulators) |  |  |  |
| 10.3.1 | At any two attachments: |  |  |  |
|  | a. either phase or | Newton | 0 |  |
|  | b. earth | Newton | 0 |  |
| **11.0** | **APPLIED LOADS – CONSTRUCTION AND MAINTENANCE LOADING CONDITIONS – LONGITUDINAL LOADS**  **Factors of safety to be applied: see the Technical Parameters.**  **For transverse and vertical loads: see Appendix C of the Technical Specification.** |  |  |  |
| 11.1 | Straight line towers (suspension insulators) |  |  |  |
| 11.1.1 | Maintenance condition: |  |  |  |
|  | a.phase | Newton |  |  |
|  | b.earth | Newton |  |  |
| 11.2 | Angle and terminal towers (tension insulators) |  |  |  |
| 11.2.1 | Temporary terminal condition: |  |  |  |
|  | a.phase | Newton |  |  |
|  | b.earth | Newton |  |  |
| 11.2.2 | Maintenance condition: |  |  |  |
|  | a.phase | Newton |  |  |
|  | b.earth | Newton |  |  |
| **12.0** | **PARTICULARS OF DOUBLE CIRCUIT TOWERS** |  |  |  |
| 12.1 | Type of Tower |  | 400S |  |
| 12.1.1 | Type of insulator sets |  | Suspension |  |
| 12.1.2 | Angles of deviation | degree | 0 – 2 |  |
| 12.1.3 | Basic span length | m | 400 |  |
| 12.1.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m | 8.1 |  |
| 12.1.5 | Sag of line conductor in span length at 80˚C | m | 12.51 |  |
| 12.1.6 | Maximum distance of line conductor below crossarm | m |  |  |
| 12.1.7 | Height above ground of bottom conductor crossarm (Standard height tower) | m | 26 |  |
| 12.1.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.1.9 | Minimum horizontal spacing between adjacent conductors | m | 6.5 |  |
| 12.1.10 | Vertical spacing between line conductors at tower: | m | 11.00 |  |
| 12.1.11 | Overall tower height (Standard height tower) | m | 38 |  |
| 12.1.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.1.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m | 9.00 |  |
| 12.1.14 | Horizontal distance, from tower centre line of insulator attachments | m | 8.00 |  |
| 12.1.15 | Horizontal distance, from tower centre line of earth conductors | m | 9.00 |  |
| 12.1.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m | 2.00x2.00 |  |
| 12.1.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.1.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.1.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| 12.2 | Type of Tower |  | 400T10 |  |
| 12.2.1 | Type of insulator set |  | Tension |  |
| 12.2.2 | Angles of deviation | degree | 0 – 10 |  |
| 12.2.3 | Basic span length | m |  |  |
| 12.2.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m |  |  |
| 12.2.5 | Sag of line conductor in span length at 80˚C | m |  |  |
| 12.2.6 | Maximum distance of line conductor below crossarm | m |  |  |
| 12.2.7 | Height above ground of bottom conductor crossarm | m |  |  |
| 12.2.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.2.9 | Minimum horizontal spacing between adjacent conductors | m | For basic and typical dimensions  see 400S |  |
| 12.2.10 | Vertical spacing between line conductors at tower: | m |  |  |
| 12.2.11 | Overall tower height | m |  |  |
| 12.2.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.2.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m |  |  |
| 12.2.14 | Horizontal distance, from tower centre line of insulator attachments | m |  |  |
| 12.2.15 | Horizontal distance, from tower centre line of earth conductors | m |  |  |
| 12.2.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m |  |  |
| 12.2.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.2.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.2.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| 12.3 | Type of tower |  | 400T30 |  |
| 12.3.1 | Type of insulator set |  | Tension |  |
| 12.3.2 | Angles of deviation | degree | 10 – 30 |  |
| 12.3.3 | Basic span length | m |  |  |
| 12.3.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m |  |  |
| 12.3.5 | Sag of line conductor in span length at 80˚C | m |  |  |
| 12.3.6 | Maximum distance of line conductor below crossarm | m | - |  |
| 12.3.7 | Height above ground of bottom conductor crossarm | m |  |  |
| 12.3.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.3.9 | Minimum horizontal spacing between adjacent conductors | m |  |  |
| 12.3.10 | Vertical spacing between line conductors at tower: | m |  |  |
| 12.3.11 | Overall tower height | m | For basic and typical dimensions  see 400S |  |
| 12.3.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.3.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m |  |  |
| 12.3.14 | Horizontal distance, from tower centre line of insulator attachments | m |  |  |
| 12.3.15 | Horizontal distance, from tower centre line of earth conductors | m |  |  |
| 12.3.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m |  |  |
| 12.3.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.3.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.3.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| 12.4 | Type of tower |  | 400T60 |  |
| 12.4.1 | Type of insulator set |  | Tension |  |
| 12.4.2 | Angles of deviation | degree | 30 – 60 |  |
| 12.4.3 | Basic span length | m |  |  |
| 12.4.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m |  |  |
| 12.4.5 | Sag of line conductor in span length at 80˚C | m |  |  |
| 12.4.6 | Maximum distance of line conductor below crossarm | m | - |  |
| 12.4.7 | Height above ground of bottom conductor crossarm | m |  |  |
| 12.4.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.4.9 | Minimum horizontal spacing between adjacent conductors | m | For basic and typical dimensions  see 400S |  |
| 12.4.10 | Vertical spacing between line conductors at tower: | m |  |  |
| 12.4.11 | Overall tower height | m |  |  |
| 12.4.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.4.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m |  |  |
| 12.4.14 | Horizontal distance, from tower centre line of insulator attachments | m |  |  |
| 12.4.15 | Horizontal distance, from tower centre line of earth conductors | m |  |  |
| 12.4.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m |  |  |
| 12.4.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.4.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.4.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| 12.5 | Type of tower |  | 400T90 |  |
| 12.5.1 | Type of insulator set |  | Tension |  |
| 12.5.2 | Angles of deviation | degree | 60 – 90 |  |
| 12.5.3 | Basic span length | m |  |  |
| 12.5.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m |  |  |
| 12.5.5 | Sag of line conductor in span length at 80˚C | m |  |  |
| 12.5.6 | Maximum distance of line conductor below crossarm | m | - |  |
| 12.5.7 | Height above ground of bottom conductor crossarm | m |  |  |
| 12.5.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.5.9 | Minimum horizontal spacing between adjacent conductors | m |  |  |
| 12.5.10 | Vertical spacing between line conductors at tower: | m |  |  |
| 12.5.11 | Overall tower height | m |  |  |
| 12.5.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.5.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m | For basic and typical dimensions see 400S |  |
| 12.5.14 | Horizontal distance, from tower centre line of insulator attachments | m |  |  |
| 12.5.15 | Horizontal distance, from tower centre line of earth conductors | m |  |  |
| 12.5.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m |  |  |
| 12.5.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.5.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.5.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| 12.6 | Type of tower |  | 400Trm |  |
| 12.6.1 | Type of insulator set |  | Terminal |  |
| 12.6.2 | Angles of deviation | degree | 0 – 45 |  |
| 12.6.3 | Basic span length | m |  |  |
| 12.6.4 | Minimum ground clearance of line conductor at 80˚C, normal ground | m |  |  |
| 12.6.5 | Sag of line conductor in span length at 80˚C | m |  |  |
| 12.6.6 | Maximum distance of line conductor below crossarm | m | - |  |
| 12.6.7 | Height above ground of bottom conductor crossarm | m |  |  |
| 12.6.8 | Minimum height of earth conductors above upper line conductor at tower | m |  |  |
| 12.6.9 | Minimum horizontal spacing between adjacent conductors | m |  |  |
| 12.6.10 | Vertical spacing between line conductors at tower: | m |  |  |
| 12.6.11 | Overall tower height | m |  |  |
| 12.6.12 | Maximum differential, foundation movement permitted under ultimate loads | mm |  |  |
| 12.6.13 | Clearance between conductors of one circuit and tower climbing leg of the other circuit: | m | For basic and typical dimensions  see 400S |  |
| 12.6.14 | Horizontal distance, from tower centre line of insulator attachments | m |  |  |
| 12.6.15 | Horizontal distance, from tower centre line of earth conductors | m |  |  |
| 12.6.16 | Tower body dimensions at bottom crossarm level (transverse x longitudinal) | m x m |  |  |
| 12.6.17 | Overall tower base dimensions at ground line (transverse x longitudinal): | m x m |  |  |
| 12.6.18 | Total transverse overturning moment at ground line of standard height tower, load case 1 with factor of safety | kN m |  |  |
| 12.6.19 | Mass of complete towers above ground line: |  |  |  |
|  | a.3 metre reduced height tower | kg |  |  |
|  | b.Standard height tower: | kg |  |  |
|  | c.3 metre extended tower | kg |  |  |
|  | d.6 metre extended tower | kg |  |  |
|  | e.9 metre extended tower | kg |  |  |
|  | f.12 metre extended tower | kg |  |  |
| **13.0** | **FOUNDATION DESIGN PARTICULARS** |  |  |  |
| 13.1 | Assumed density of concrete for foundation dry | kg/m3 | 2240 |  |
| 13.2 | Assumed density of concrete for foundation submerged | kg/m3 | 1200 |  |
| 13.3 | Maximum angle between base and side of concrete foundation for uplift “frustum” to be taken from base of foundation | degree | 70 |  |
| 13.4 | Maximum allowable design stresses in standard concrete foundation design, under ultimate conditions, shall be in accordance with BS 8110 or BS 5328, with the following requirement: |  |  |  |
|  | 1. 28-day concrete cube strength (characteristic strength) | N/mm2 | 25 |  |
|  | 1. Minimum proportion of stub load to be allowed for in the design of stub cleats | % | 100 |  |
| 13.5 | Foundation excavation dimensions for 400S type foundation in class 2 soil (a x b x depth) | m x m x m |  |  |
| 13.6 | Concrete volume for 400S type foundation in class 2 soil | m3 |  |  |
| **14.0** | **QUALITY OF TOWER MATERIALS** |  |  |  |
| 14.1 | Steel members |  |  |  |
| 14.1.1 | Grade/standard: |  | EN10025-2 |  |
|  | a.Mild steel |  | S235 |  |
|  | b.High tensile steel |  | S355 |  |
| 14.1.2 | Tensile breaking stress: |  |  |  |
|  | a.Mild steel | N/mm2 | 235 |  |
|  | b.High tensile steel | N/mm2 | 355 |  |
| 14.1.3 | Elongation on breaking: |  |  |  |
|  | a.Mild steel | % |  |  |
|  | b.High tensile steel | % |  |  |
| 14.1.4 | Yield point as percentage of breaking stress: |  |  |  |
|  | a.Mild steel | % |  |  |
|  | b.High tensile steel | % |  |  |
| 14.2 | Steel nuts and bolts |  |  |  |
| 14.2.1 | Grade/standard: |  |  |  |
|  | a.Mild steel |  | 5.6 |  |
|  | b.High tensile steel |  | 8.8 |  |
| 14.2.2 | Tensile breaking stress: |  |  |  |
|  | a.Mild steel | N/mm2 |  |  |
|  | b.High tensile steel | N/mm2 |  |  |
| 14.2.3 | Elongation on breaking: |  |  |  |
|  | a.Mild steel | 1. % |  |  |
|  | b.High tensile steel | 1. % |  |  |

## 132kV OHL

| **TECHNICAL DATA SCHEDULE**  **132 kV OHL ACSR LYNX CONDUCTOR** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | ACSR |  |
| 1.2 | Code Name |  | LYNX |  |
| 1.3 | Details of material and standard to which conforming  Steel  Aluminium  Zinc  Composite conductor |  |  |  |
|  |  |  |  |  |
| 1.4 | Designation | - | - |  |
| 1.5 | Country of Origin | - | - |  |
| 2.0 | Mechanical characteristics and dimensions |  |  |  |
| 2.1 | Stranding | - | 30/7 |  |
| 2.2 | Aluminium wire diameter | mm | 2.79 |  |
| 2.3 | Galvanized steel wire diameter | mm | 2.79 |  |
| 2.4 | Overall diameter | mm | 19.53 |  |
| 2.5 | Aluminium area | mm2 | 193.4 |  |
| 2.6 | Steel area | mm2 | 42.79 |  |
| 2.7 | Overall area | mm2 | 226.2 |  |
| 2.8 | Greased | - | Yes (drop point 1200C) |  |
| 2.9 | Mass | kg/km | 842 |  |
| 2.10 | Rated tensile strength | kN | 79.8 |  |
| 2.11 | Initial lower modulus of elasticity | GPa | - |  |
| 2.12 | Initial upper modulus of elasticity | GPa | - |  |
| 2.13 | Transition stress | MPa | - |  |
| 2.14 | Final modulus of elasticity | GPa | - |  |
| 2.15 | Equivalent temperature difference for Creep compensation | 0C | - |  |
| 2.16 | Coefficient of linear thermal expansion | E-6/0C | - |  |
| 2.17 | Lay ratio (Max. and min.)  Steel core  6 layers  Aluminium  12 layers  18 layers |  |  |  |
| 2.18 | Weight  Aluminium wire  Before stranding  After stranding  Galvanized steel wire  Before stranding  After stranding | Kg/km |  |  |
| 2.19 | D.C. resistance at 200C | ohms/km | 0.1576 |  |
| 3.0 | Transport |  |  |  |
| 3.1 | Standard length of conductor per reel | m | - |  |
| 3.2 | Maximum number of standard lengths per reel | km | 2 |  |
| 3.3 | Flange diameter | mm | - |  |
| 3.4 | Inside traverse | mm | - |  |
| 3.5 | Overall width | mm | - |  |
| 3.6 | Drum diameter | mm | - |  |
| 3.7 | Minimum cover from edge of flange | mm | 25 |  |
| 3.8 | Arbor hole diameter | - | - |  |
| 3.9 | Material | mm | Wood |  |
| 3.10 | Empty reel mass | kg | - |  |
| 3.11 | Thickness of lagging | mm | - |  |
| 3.12 | Shipping mass | kg | - |  |
| 3.13 | Shipping volume | m3 | - |  |
| 3.14 | Max. back tension the drum is suitable to with stand from the tensioner used for tension stringing |  |  |  |
| 4.0 | Drawings |  |  |  |
| 4.1 | Conductor cross section |  | yes |  |
| 4.2 | Drum drawing indicating dimensions, bill of material, marking, end fixation arrangement, etc. |  | yes |  |
| 4.3 | Supply reference |  | yes |  |
| 4.4 | Type test report |  | yes |  |
| 5.0 | Standards |  |  |  |
| 5.1 | Manufacturing (Complete Conductor)  Aluminium wires  Steel wires  Grease  For conductor creep | - | ASTM B232 EN 60889  EN 50189  EN 50326  IEC 61395 |  |
| 5.2 | Quality Assurance | - | ISO 9001 |  |
| 6.0 | Installation |  | Outdoor Tropical environment |  |

Notes

Tolerances, where applicable, may be indicated

No joint shall be made in the aluminium strand of the outer layer of the conductor.

No joint is permitted in the steel core

The parameters of aluminium and steel strands and their chemical composition may also be furnished and guaranteed.

Where two lengths of conductor are in one drum, a red tag will be placed at 50m from the finishing end of each length and a temporary weld joint be made to inform the stringing supervisor about the finish end of one conductor length.

| **TECHNICAL DATA SCHEDULE**  **OVERHEAD FIBER OPTIC GROUND WIRE** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | OPGW |  |
| 1.2 | Designation | - | - |  |
| 1.3 | Country of origin | - | - |  |
| 2.0 | Dimensions and Mechanical characteristics |  |  |  |
| 2.1 | Aluminium wires |  |  |  |
| 2.1.1 | Number and diameter of wires | mm | 2.5 min. |  |
| 2.1.2 | Aluminium type | - | 1350 H19 |  |
| 2.1.3 | Ultimate Tensile Strength | kN | - |  |
| 2.1.4 | Elongation (sample 200 mm) | % | - |  |
| 2.2 | Other wires |  |  |  |
| 2.2.1 | Number and diameter of steel or aluminium alloy wires | mm | ----, 2.5 min. |  |
| 2.2.2 | Type of metal | - | 6101-T81 or T83, 5005-H19 aluminium clad steel |  |
| 2.2.3 | Ultimate tensile strength | kN | - |  |
| 2.2.4 | Elongation (sample 200 mm) | % | - |  |
| 2.3 | Aluminium area | mm2 | - |  |
| 2.4 | Area of Steel or Aluminium Alloy | mm2 | 45 |  |
| 2.5 | Section of wires | - | Round or trapezoidal |  |
| 2.6 | External diameter of F.O. Tube | mm | 5.5 |  |
| 2.7 | Overall cable diameter | mm | 10.3 |  |
| 2.8 | Cross Section of Cable | mm2 | 59 |  |
| 2.9 | Weight of cable | kg/km | 355 |  |
| 2.10 | Mechanical strength of cable | - | - |  |
| 2.10.1 | Ultimate tensile strength | kN | 60 |  |
| 2.10.2 | Maximum traction for normal operation  (10-60 0C) with elongation of | kN  % | - |  |
| 2.10.3 | Maximum traction without damage | kN |  |  |
| 2.11 | Stress – strain curve |  | To be enclosed |  |
| 2.12 | Initial Modulus of elasticity | GPa | - |  |
| 2.13 | Final Modulus of elasticity | GPa | 162 |  |
| 2.14 | Coefficient of linear thermal expansion | /0C x 10-6 | 13 |  |
| 2.15 | Drawing showing section of cable | - | To be enclosed |  |
| 3.0 | Electrical characteristics |  |  |  |
| 3.1 | Resistance DC at 200C | OHMS/km | - |  |
| 3.2 | Coefficient of variation of resistance with temperature | /0C | - |  |
| 3.3 | Short-circuit current capacity at 400C | KA2.s | 23 |  |
| 3.4 | Short-circuit current withstand for 1s | KA | 4.8 |  |
| 3.5 | Lightning strike for 0.5s | kA |  |  |
| 4.0 | Characteristics of Optic Fibers |  |  |  |
| 4.1 | Number of fibers | - | 48 |  |
| 4.2 | Type of fibers | - | ITU-T G652 |  |
| 4.3 | Fiber core | - | Si 02 |  |
| 4.4 | Diameter of fiber | μm | - |  |
| 4.5 | Optic fiber cladding |  |  |  |
| 4.5.1 | Diameter | μm | 125 |  |
| 4.5.2 | Non-Circularity | % | ≤ 1 |  |
| 4.5.3 | Concentricity | μm | < 0.5 |  |
| 4.6 | Coating diameter | μm | 250± 10 |  |
| 4.7 | Identification | - | Color coding  TIA/EIA-598 ("Telcordia Code") |  |
| 4.8 | Filling | - | - |  |
| 4.8.1 | Composition | - | - |  |
| 4.8.2 | Characteristics - non-Hygroscopic and sealed  - No impurity  - Non-Conductive  - Homogenous  - Thermal Stability | - | yes  yes  yes  yes  yes |  |
| 4.9 | Protection Tube |  |  |  |
| 4.9.1 | External Diameter | - | - |  |
| 4.9.2 | Type of material | - | - |  |
| 4.9.3 | Circularity | % | ± 2 |  |
| 4.9.4 | Sealed | - | yes |  |
| 4.9.5 | No joint or splicing | - | yes |  |
| 4.9.6 | Stability | 0C | 0 to 65 |  |
| 4.10 | Attenuation |  |  |  |
| 4.10.1 | Max attenuation coefficient at 20 0C at 1550nm | db/km | 0.23 |  |
| 4.10.2 | Variation with temperature – 55 to 85 0C (1550 nm) | db/km | < 0.03 |  |
| 4.10.3 | Variation with wavelength (1525 to 1575 nm) | db/km | < 0.05 |  |
| 4.10.4 | Cyclic variation of temperature | db/km | < 0.1 |  |
| 4.10.5 | Variation with temperature rise caused by:   * Lightning * Short-circuit current | db/km  db/km | < 0.1  < 1.0 |  |
| 4.11 | Chromatic dispersion | ps/nm.km | < 3.5 |  |
| 4.12 | Cut-off wavelength | nm | < 1260 |  |
| 4.13 | Field diameter 1310/1550 nm | µm | 9.2 µm ± 0.4 µm/ 10.4 µm ± 0.8 µm |  |
| 4.14 | Max. dispersion | Ps/nm.km | ≤3.5ps/km.nm@1310nm and 18ps/km.nm@1550nm |  |
| 5.0 | Transport |  |  |  |
| 5.1 | Standard length of OPGW per reel | m | - |  |
| 5.2 | Maximum number of standard lengths per reel |  | 1 |  |
| 5.3 | Flange diameter | mm | - |  |
| 5.4 | Inside traverse | mm | - |  |
| 5.5 | Overall width | mm | - |  |
| 5.6 | Drum diameter | mm | - |  |
| 5.7 | Minimum cover from edge of flange | mm | 25 |  |
| 5.8 | Arbor hole diameter | - | - |  |
| 5.9 | Material | mm | Seasoned soft Wood |  |
| 5.10 | Empty reel mass | kg | - |  |
| 5.11 | Thickness of lagging | mm | - |  |
| 5.12 | Shipping mass | kg |  |  |
| 5.13 | Shipping volume | m3 | - |  |
| 5.14 | Max. back tension the drum is suitable to with stand from the tensioner used for tension stringing | N |  |  |
| 6.0 | Drawings |  |  |  |
| 6.1 | OPGW cross section |  | yes |  |
| 6.2 | Composition of the optical fibre and color coding |  | yes |  |
| 6.3 | Details about protection of moisture ingress |  | yes |  |
| 6.4 | Details of water blocking compound and also removal process of the compound |  | yes |  |
| 6.5 | Details about handling and installation techniques |  | yes |  |
| 6.6 | Details about the jointing procedure |  | yes |  |
| 6.7 | Drum drawing indicating dimensions, bill of material, marking, end fixation arrangement, etc. |  | yes |  |
| 6.8 | Supply reference |  | yes |  |
| 6.9 | Type test report |  | yes |  |
| 7.0 | Standards |  |  |  |
| 7.1 | Manufacturing | - | ASTM 398  ASTM 415  ASTM 502 ANSI/EIA 455 ANSI/EIA 359 IEEE 1138  ITU-T G652.D |  |
| 7.2 | Quality assurance | - | ISO 9001 |  |
| 8.0 | Installation | - | Outdoor Tropical environment |  |

Note:

Tolerances, where applicable, may be indicated

No joint is permitted in the outer Aluminium strands

The single Length of OPGW to be manufactured shall be checked from the route profile to avoid cut pieces, etc.

| **TECHNICAL DATA SCHEDULE**  **COUNTERPOISE GROUNDING WIRE/ EARTH RODS** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| A | Counterpoise |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | Zinc-coated steel wire strand |  |
| 1.2 | Designation |  | - |  |
| 1.3 | Details of material and standard to which conforming  Steel  Zinc |  |  |  |
| 1.3 | Country of Origin | - | - |  |
| 2.0 | Mechanical characteristics and dimensions |  |  |  |
| 2.1 | Number of wires | - | 7 |  |
| 2.2 | Wire diameter | mm | 3.25 |  |
| 2.3 | Overall diameter | mm | 9.8 |  |
| 2.4 | Steel area | mm2 | 58.1 |  |
| 2.5 | Mass | kg/km | 460 |  |
| 2.6 | Steel grade | - | Extra-high strength |  |
| 2.7 | Elongation (sample 200mm) | - | - |  |
| 2.8 | Ultimate tensile strength | kN | 66.8 |  |
| 2.9 | Modulus of elasticity | h Bar | 1800 |  |
| 2.10 | Zinc coating class and weight of zinc coating | G/m2 | - |  |
| 2.11 | D.C. resistance | Ohm/km | - |  |
| 2.12 | Lay length | mm | - |  |
| 2.13 | Details of protective coating given on wire to prevent formation of white rust during shipment and storage |  |  |  |
| 3.0 | Transport |  |  |  |
| 3.1 | Standard length of conductor per reel | m | - |  |
| 3.2 | Maximum number of standard lengths per reel |  | 1 |  |
| 3.3 | Flange diameter | mm | - |  |
| 3.4 | Inside traverse | mm | - |  |
| 3.5 | Overall width | mm | - |  |
| 3.6 | Drum diameter | mm | - |  |
| 3.7 | Minimum cover from edge of flange | mm | 25 |  |
| 3.8 | Arbor hole diameter | - | - |  |
| 3.9 | Material | mm | Seasoned soft Wood |  |
| 3.10 | Empty reel mass | kg | - |  |
| 3.11 | Thickness of lagging | mm | - |  |
| 3.12 | Shipping mass | kg | - |  |
| 3.13 | Shipping volume | m3 | - |  |
| 3.14 | Max. back tension the drum is suitable to with stand from the tensioner used for tension stringing |  |  |  |
| 4.0 | Drawings |  |  |  |
| 4.1 | Counterpoise cross section |  | yes |  |
| 4.2 | Dimensioned Drum drawing, BoM, marking, end fixation arrangement, etc. |  | yes |  |
| 4.3 | Supply reference |  | yes |  |
| 4.4 | Type test report |  | yes |  |
| 5.0 | Standards |  |  |  |
| 5.1 | Manufacturing | - | BS 183 IEC 60888 |  |
| 5.2 | Quality assurance | - | ISO 9001 |  |
| 6.0 | Installation |  | Outdoor Tropical environment |  |
| B | Earth rods |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | Round steel galvanised |  |
| 1.2 | Country of origin |  |  |  |
| 1.4 | Length | mm | 1500 |  |
| 1.5 | Diameter | mm | 15 |  |
| 1.6 | Zinc coat thickness | m | 85 |  |
| 1.7 | Compression type connector |  | steel |  |
| 2.0 | Drawings |  |  |  |
| 2.1 | Drawing of each type of earthing set with dimensions |  | yes |  |
| 2.2 | Drawing of earthing clamp with dimensions |  | yes |  |
| 3.0 | Standard |  |  |  |
| 3.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461 |  |
| 3.2 | Quality assurance | - | ISO 9001 |  |
| 4.0 | Installation | - | Outdoor tropical environment |  |

Notes

Tolerances, where applicable, may be indicated

No joint is permitted in the steel wire

The parameters of steel strands and their chemical composition may also be furnished and guaranteed

| **TECHNICAL DATA SCHEDULE**  **132 kV OHL FOR TOWERS AND FOUNDATIONS** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Tower | - | - |  |
| 1.1 | Manufacturer/ Fabricator Name and address |  |  |  |
| 1.2 | Name and address of supplier of materials   * + - 1. Steel       2. Zinc       3. Bolts and nuts       4. Tower hardware       5. Galvanized spring washers       6. Galvanization |  |  |  |
| 1.3 | Governing Standards for materials at 1.2 above. |  |  |  |
| 1.4 | Design Parameters |  |  |  |
| 1.4.1 | Basic wind velocity (Vb,0) (m/s)  At minimum temperature(8°C) | m/s |  |  |
| 1.4.2 | Temperature  Every day temperature  Minimum temperature  Maximum temperature   * + 1. Conductor   ii) Ground wire | °C  °C  °C  °C |  |  |
| 1.4.3 | Protection against lightning  i) Angle of shield  132 kV   1. Mid span clearance | Degree  m | 30  max. (5m, 30degree shield wire |  |
| 1.4.3 | Air clearance  Suspension tower   1. 132 kV   -Swing angle (0-200)  -Swing angle (400)  -Swing angle (600)  Jumper (Tension tower)   1. 132 kV   -Swing angle (0-250) | mm  mm  mm  mm  mm | 1350  1140  830  1350 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| 1.4.4 | Maximum ultimate stress  Compression members  Mild steel  High tensile steel  Tension members  Mild steel  High tensile steel | N/mm2  N/mm2  N/mm2  N/mm2 | 235  355 |  |
| 1.4.5 | Shear on bolts  Mild steel  H,T.steel  Bearing on bolts  Mild steel  H,T.steel | N/mm2  N/mm2  N/mm2  N/mm2 | As per ACSE 10-97 Clause 4.3  (Contractor to indicate the values) |  |
| 1.4.6 | Slenderness ratio  Leg members, G.W.Peak and X-arm lower members  Bracings  Redundant / Nominal stress carrying members  Tension members |  | 120  200  250  400 |  |
| 1.4.7 | Minimum Flange Width  Bolt dia. 16/ 20 | mm | 45/ 50 |  |
| 1.4.8 | Minimum thickness of members  Leg/ Ground wire peak and external members of horn members/ lower cross arm  Upper members of X-arm/ Bracing and inner members of horn peak/ Other members | mm  mm | 6  5 |  |
| 1.4.9 | Chemical Composition (Mild) steel/ H.T. Steel  Carbon  Manganese  Phosphorus  Sulphur  Silicon  Mechanical Properties  Tensile strength  Yield Strength  Elongation (minimum) | %  %  %  %  %  Kg/mm2  Kg/mm2% | As per standards |  |
| 1.4.10 | Nominal length, clamping length and weight of bolts of size(diameter) in mm and in kg  16mm  20mm |  |  |  |
| 1.4.11 | Spacing of bolts and Edge distances corresponding to bolt diameter  16mm  20mm | mm  mm |  |  |
| 1.4.12 | Galvanized spring washers’ weight and thickness corresponding to both diameter  16mm  20mm |  |  |  |
| 2.0 | Foundation |  |  |  |
| 2.1 | Name and address of supplier  Cement  Coarse aggregate  Fine aggregate |  |  |  |
| 2.2 | Governing standards  Cement  Coarse aggregate  Fine aggregate  Water |  |  |  |
| 2.3 | Concrete mix  Grade  Composition by grade  Cement  Coarse aggregate  Fine aggregate  Water |  |  |  |
| 2.4 | Bond stresses(Limit)  Between concrete and reinforcement steel deformed bars in tension  With M:15  With M:25  Between concrete and reinforcement steel deformed bars in tension  With M:15  With M:25 |  |  |  |
|  | Between concrete and stubs in tension  With M:15  With M:25  Between Rock and Concrete  Fissured rock  Hard rock  Between Hard Rock and grout |  |  |  |
|  |  |  |  |  |
| 2.5 | Assumed density of earth pile  Foundations |  |  |  |
| 2.6 | Assumed angle to the vertical of sides of frustum of earth resisting uplift degree  I Light concrete foundation  Ii Heavy concrete foundation |  |  |  |
| 2.7 | Maximum angle between base and side of concrete foundation for uplift conditions  Assumed density of foundation concrete  Density of earth for foundation  Ultimate earth pressure  Ultimate Lateral earth pressure for foundation Shear forces, per meter of depth |  |  |  |
| 2.8 | Assumed depth of application of resultant lateral Earth pressure below ground line to top of foundation block. |  |  |  |
| 2.9 | Maximum ultimate allowable stresses in concrete for foundation design:  Tensile stress due to bending  Bond stress, galvanized steel/concrete  Bearing stress  Punching shear stress |  |  |  |
| 2.10 | 28-day cube strength (1:2:4) (after allowing for deviations) | N/mm2 | 25 |  |
| 2.11 | Minimum portion of stub loads to be allowed for in the design of stub cleat |  |  |  |

| **TECHNICAL DATA SCHEDULE**  **70 kN COMPOSITE INSULATORS** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1  1.2 | Type  Country of Origin | - | Composite |  |
| 1.3 | Coupling | - | Ball and socket |  |
| 1.4 | Color |  | Grey |  |
| 1.5 | Surface |  | Smooth |  |
| 1.6 | Core FRP rod |  | Boron free ECR |  |
| 1.7 | Housing |  | Single Mould |  |
| 1.8 | Housing material |  | Silicon rubber |  |
| 1.9 | End fitting |  | Acquistic method |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1 | Ball and socket diameter | mm | 16 |  |
| 2.2a | Minimum creepage distance per string | mm/kV | 31 |  |
| 2.2b | Creepage distance | mm | 4495 |  |
| 2.2c | Outside diameter |  |  |  |
| 2.2d | Number of sheds |  |  |  |
| 2.3 | Combined mechanical and electrical strength | kN | 70 |  |
| 2.4 | Power frequency withstand voltage dry | kVp |  |  |
| 2.5 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.6 | Impulse withstand voltage | kVp | 650 |  |
| 2.7 | Visual corona discharge voltage | kVrms |  |  |
| 2.8 | RIV Data: |  |  |  |
|  | - Low frequency test voltage | kVrms | 113 |  |
|  | - Max RIV | µV@1MHz | 48 |  |
| 2.9 | Insulation length of string (dry arc distance) min | mm | 1450 |  |
| 2.10 | Total length with hardware | mm |  |  |
| 2.11 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 2.12 | Weight of one unit | kg | - |  |
| 3.0 | Transport |  |  |  |
| 3.1 | Size of crates: |  |  |  |
|  | - Length x diameter | mm | - |  |
| 3.2 | Number of insulators: |  |  |  |
|  | - Per crate | Unit | - |  |
| 3.3 | Weight of a crate | kg | - |  |
| 4.0 | Drawings |  |  |  |
| 4.1 | Dimensioned -120 kN composite insulator |  | yes |  |
| 4.2 | Supply reference of composite insulator |  | yes |  |
| 4.3 | Type test report |  | yes |  |
| 5.0 | Standard |  |  |  |
| 5.1 | Manufacturing | - | IEC 61109  IEC 60372 IEC 60120 |  |
| 5.2 | Quality assurance | - | ISO 9001 |  |
| 6.0 | Installation | - | Outdoor tropical environment |  |

Note :

Tolerances, as applicable, shall be indicated

No negative tolerance on creepage distance

Corresponding to withstand voltages, the flash over voltages of insulator may also be guaranteed

| **TECHNICAL DATA SCHEDULE**  **120 kN COMPOSITE INSULATORS** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1  1.2 | Type  Country of Origin | - | Composite |  |
| 1.3 | Coupling | - | Ball and socket |  |
| 1.4 | Color |  | Grey |  |
| 1.5 | Surface |  | Smooth |  |
| 1.6 | Core FRP rod |  | Boron free ECR |  |
| 1.7 | Housing |  | Single Mould |  |
| 1.8 | Housing material |  | Silicon rubber |  |
| 1.9 | End fitting |  | Acquistic method |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1 | Ball and socket diameter | mm | 16 |  |
| 2.2a | Minimum creepage distance per string | mm/kV | 31 |  |
| 2.2b | Creepage distance | mm | 4495 |  |
| 2.2c | Outside diameter |  |  |  |
| 2.2d | Number of sheds |  |  |  |
| 2.3 | Combined mechanical and electrical strength | kN | 120 |  |
| 2.4 | Power frequency withstand voltage dry | kVp |  |  |
| 2.5 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.6 | Impulse withstand voltage | kVp | 650 |  |
| 2.7 | Visual corona discharge voltage | kVrms |  |  |
| 2.8 | RIV Data: |  |  |  |
|  | - Low frequency test voltage | kVrms | 113 |  |
|  | - Max RIV | µV@1MHz | 48 |  |
| 2.9 | Insulation length of string (dry arc distance) min | mm | 1450 |  |
| 2.10 | Total length with hardware | mm |  |  |
| 2.11 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 2.12 | Weight of one unit | kg | - |  |
| 3.0 | Transport |  |  |  |
| 3.1 | Size of crates: |  |  |  |
|  | - Length x diameter | mm | - |  |
| 3.2 | Number of insulators: |  |  |  |
|  | - Per crate | Unit | - |  |
| 3.3 | Weight of a crate | kg | - |  |
| 4.0 | Drawings |  |  |  |
| 4.1 | Dimensioned -120 kN composite insulator |  | yes |  |
| 4.2 | Supply reference of composite insulator |  | yes |  |
| 4.3 | Type test report |  | yes |  |
| 5.0 | Standard |  |  |  |
| 5.1 | Manufacturing | - | IEC 61109  IEC 60372 IEC 60120 |  |
| 5.2 | Quality assurance | - | ISO 9001 |  |
| 6.0 | Installation | - | Outdoor tropical environment |  |

Note :

Tolerances, as applicable, shall be indicated

No negative tolerance on creepage distance

Corresponding to withstand voltages, the flash over voltages of insulator may also be guaranteed

| **Technical Data Schedule**  **of 132 kV SINGLE Suspension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1  1.2 | Type  Country of Origin | - | I -single suspension |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX with armor rods |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4  2.5a | E.M. strength (except clamp)  Slip strength of suspension clamp | kN  kN | 1 x 70 |  |
| 2.5b | Clamp material |  | AL alloy |  |
| 2.6 | Minimum conductor deflection angle at suspension clamp | Degrees | 20 |  |
| 2.7 | No. of composite insulator string | Nos. | 1 |  |
| 2.8 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.9 | Lightning impulse flash over voltage | kVp | - |  |
| 2.10 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.11 | Switching impulse flash over voltage | kVp | NA |  |
| 2.12 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.13 | Power frequency flash over voltage (wet) | kVrms | - |  |
| 2.14 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.15 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.16 | RIV at 113 kVrms phase – ground | uV/ |  |  |
| 2.17 | Creepage distance (min.) | mm | 4495 |  |
| 2.18 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per standard |  |
| 2.19 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.20 | Max. length of insulator string (see tower clearance drwgs) | mm | 2150 |  |
| 2.21 | Weight of the hardware | kg |  |  |
| 2.22 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 kV Jumper SINGLE Suspension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1  1.2 | Type  Country of Origin | - | I -single suspension |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX with armor rods |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4  2.5a | E.M. strength (except clamp)  Slip strength of suspension clamp | kN  kN | 1 x 70 |  |
| 2.5b | Clamp material |  | AL alloy |  |
| 2.6 | Minimum conductor deflection angle at suspension clamp | Degrees | 20 |  |
| 2.7 | No. of composite insulator string | Nos. | 1 |  |
| 2.8 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.9 | Lightning impulse flash over voltage | kVp | - |  |
| 2.10 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.11 | Switching impulse flash over voltage | kVp | NA |  |
| 2.12 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.13 | Power frequency flash over voltage (wet) | kVrms | - |  |
| 2.14 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.15 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.16 | RIV at 113 kVrms phase – ground | uV/ |  |  |
| 2.17 | Creepage distance (min.) | mm | 4495 |  |
| 2.18 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.19 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.20 | Max. length of insulator string (see tower clearance drwgs) | mm | 2150 |  |
| 2.21 | Weight of the hardware | kg |  |  |
| 2.22 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 KV DOUBLE Suspension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1  1.2 | Type  Country of Origin | - | II -double suspension |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX with armor rods |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4 | E.M. strength (except clamp) | kN | 2x70 |  |
| 2.5a | Slip strength of suspension clamp | kN |  |  |
| 2.5b | Clamp material |  | AL alloy |  |
| 2.6 | Minimum conductor deflection angle at suspension clamp | Degrees | 20 |  |
| 2.7 | No. of composite insulator string | Nos. | 2 |  |
| 2.8 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.9 | Lightning impulse flash over voltage | kVp | - |  |
| 2.10 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.11 | Switching impulse flash over voltage | kVp | NA |  |
| 2.12 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.13 | Power frequency flash over voltage (wet) | kVms | - |  |
| 2.14 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.15 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.16 | RIV at 113 kVrms phase – ground | uV/ |  |  |
| 2.17 | Creepage distance (min.) | mm | 4495 |  |
| 2.18 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.19 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.20 | Max. length of insulator string (see tower clearance drwgs) |  | 2250 |  |
| 2.21 | Weight of the hardware | kg |  |  |
| 2.22 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 kV Single Tension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | single tension |  |
| 1.2 | Country of origin | - | - |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4 | E.M. strength (except clamp) | kN | 1 x 120 |  |
| 2.5 | Slip strength of tension clamp | kN |  |  |
| 2.6 | No. of composite insulator string | Nos. | 1 |  |
| 2.7 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.8 | Lightning impulse flash over voltage | kVp | - |  |
| 2.9 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.10 | Switching impulse flash over voltage | kVp | NA |  |
| 2.11 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.12 | Power frequency flash over voltage (wet) | kVms | - |  |
| 2.13 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.14 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.15 | RIV at 113 kVrms phase – ground | uV |  |  |
| 2.16 | Creepage distance (min.) | mm | 4495 |  |
| 2.17 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.18 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.19 | Max. length of insulator string (see tower clearance drwgs) | mm | 2450 |  |
| 2.20 | Weight of the hardware | kg |  |  |
| 2.21 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
|  |  |  |  |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 kV Inverted Tension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | single tension |  |
| 1.2 | Country of origin | - | - |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4 | E.M. strength (except clamp) | kN | 1 x 120 |  |
| 2.5 | Slip strength of tension clamp | kN |  |  |
| 2.6 | No. of composite insulator string | Nos. | 1 |  |
| 2.7 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.8 | Lightning impulse flash over voltage | kVp | - |  |
| 2.9 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.10 | Switching impulse flash over voltage | kVp | NA |  |
| 2.11 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.12 | Power frequency flash over voltage (wet) | kVms | - |  |
| 2.13 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.14 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.15 | RIV at 113 kVrms phase – ground | uV/ |  |  |
| 2.16 | Creepage distance (min.) | mm | 4495 |  |
| 2.17 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.18 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.19 | Max. length of insulator string (see tower clearance drwgs) | mm | 2500 |  |
| 2.20 | Weight of the hardware | kg |  |  |
| 2.21 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
|  |  |  |  |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 kV Light Duty Tension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | single tension |  |
| 1.2 | Country of origin | - | - |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4 | E.M. strength (except clamp) | kN | 1 x 120 |  |
| 2.5 | Slip strength of tension clamp | kN |  |  |
| 2.6 | No. of composite insulator string | Nos. | 1 |  |
| 2.7 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.8 | Lightning impulse flash over voltage | kVp | - |  |
| 2.9 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.10 | Switching impulse flash over voltage | kVp | NA |  |
| 2.11 | Power frequency withstand voltage (wet) | kVrms | 275 |  |
| 2.12 | Power frequency flash over voltage (wet) | kVms | - |  |
| 2.13 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.14 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.15 | RIV at 113 kVrms phase – ground | uV |  |  |
| 2.16 | Creepage distance (min.) | mm | 4495 |  |
| 2.17 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.18 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.19 | Max. length of insulator string (see tower clearance drwgs) | mm | 2450 |  |
| 2.20 | Weight of the hardware | kg |  |  |
| 2.21 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference | - | yes |  |
| 3.4 | Type test report |  | yes |  |
|  |  |  |  |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of 132 kV Double Tension Insulator Strings With Composite Insulators** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type | - | Double tension |  |
| 1.2 | Country of origin | - | - |  |
| 1.3 | Coupling | - | ball & socket |  |
| 2.0 | Nominal characteristics |  |  |  |
| 2.1a | Ball and socket designation | mm | 16 |  |
| 2.1b | Locking device material |  | Stainless steel or phosphor bronze |  |
| 2.2 | Conductor type |  | ACSR LYNX |  |
| 2.3 | Maximum system voltage | kV | 145 |  |
| 2.4 | E.M. strength (except clamp) | kN | 2 x 120 |  |
| 2.5 | Slip strength of tension clamp | kN |  |  |
| 2.6 | No. of composite insulator string | Nos. | 2 |  |
| 2.7 | Lightning impulse with stand voltage (min) | kVp | 650 |  |
| 2.8 | Lightning impulse flash over voltage | kVp | - |  |
| 2.9 | Switching impulse with stand voltage (min) | kVp | NA |  |
| 2.10 | Switching impulse flash over voltage | kVp | NA |  |
| 2.11 | Power frequency withstand voltage | kVrms | 275 |  |
| 2.12 | Power frequency flash over voltage (wet) | kVms | - |  |
| 2.13 | Corona extinction voltage (phase-ground) | kVrms | 113 |  |
| 2.14 | Short circuit withstand for 1 sec (any part of the set) | kA | 31.5 |  |
| 2.15 | RIV at 113 kVrms phase – ground | uV/ |  |  |
| 2.16 | Creepage distance (min.) | mm | 4495 |  |
| 2.17 | Arcing distance between the line side grading ring and tower side arcing horn (minimum) | mm | as per Standard |  |
| 2.18 | Suitability of insulator string for hot line maintenance | - | Yes |  |
| 2.19 | Max. length of insulator string (see tower clearance drwgs) | mm | 2600 |  |
| 2.20 | Weight of the hardware | kg |  |  |
| 2.21 | Weight of zinc coating (min.) on ferrous parts | g/m2 | 610 |  |
| 3.0 | Drawings |  |  |  |
| 3.1 | Dimensioned drawing of insulator string | - | yes |  |
| 3.2 | Dimensioned drawings of all accessories | - | yes |  |
| 3.3 | Insulator string supply reference |  | yes |  |
| 3.4 | Type test report |  |  |  |
|  |  |  |  |  |
| 4.0 | Standard |  |  |  |
| 4.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC60383  IEC60120  IEC60372 |  |
| 4.2 | Quality assurance | - | ISO 9001 |  |
| 5.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

Note:

Tolerances, where applicable, may be indicated

No negative tolerance is permitted on the creepage distance

All flashover and withstand voltage levels to be corrected to normal temperature and pressure as per IEC 60071

| **Technical Data Schedule**  **of OPGW accessories and hardware sets / Vibration dampers** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| A | Accessories for the OPGW |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Country of Origin |  |  |  |
| 1.2 | Parts of iron material are galvanised | - | yes |  |
| 1.3 | Galvanising process |  | Hot dip |  |
| B | Suspension assemblies for OPGW |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type |  |  |  |
| 1.2 | Country of Origin |  |  |  |
| 1.3 | Connection with the OPGW | system |  |  |
| 1.4 | Material used for |  |  |  |
|  | Clamp body | material |  |  |
|  | Clamp protection | material |  |  |
|  | Spiral wires | material |  |  |
| 1.5 | Suitable for cross-section of OPGW | mm2 |  |  |
| 1.6 | Minimum failing load referred to maximum simultaneous acting forces | % |  |  |
| 1.7 | Slipping load | kN |  |  |
| 1.8 | Short circuit withstand for 1 sec | kA | 31.5 |  |
| 1.9 | Weight of the suspension assembly | kg |  |  |
| C | Tension assemblies for OPGW |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type |  |  |  |
| 1.2 | Country of Origin |  |  |  |
| 1.3 | Connection with the OPGW | system |  |  |
| 1.4 | Material used for |  |  |  |
|  | Clamp body | material |  |  |
|  | Clamp protection | material |  |  |
|  | Spiral wires | material |  |  |
|  | Dead end helical grips | material |  |  |
|  | Helical grips for protection and suitable for vibration damper | material |  |  |
| 1.5 | Suitable for cross-section of OPGW | mm2 |  |  |
| 1.6 | Minimum failing load referred to maximum simultaneous acting forces | % |  |  |
| 1.7 | Slipping load | kN |  |  |
| 1.8 | Short circuit withstand for 1 sec | kA | 31.5 |  |
| 1.9 | Weight of the tension assembly | kg |  |  |
| D | Joint box OPGW-OPGW and OPGW-OFAC |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1 | Type |  |  |  |
|  | Along the overhead line | type |  |  |
|  | At the substation gantry | type |  |  |
| 1.2 | Country of origin |  |  |  |
| 1.3 | Number of cable entries | No. |  |  |
| 1.4 | Locking facilities |  | yes |  |
| 1.5 | Splice spare length | m | 1 |  |
| 1.6 | Outer box material | material | Oil Resistant |  |
| 1.7 | Enclosure completes with organiser tray or |  | Yes/no |  |
| 1.8 | Splice cassette |  | Yes/no |  |
|  | * Accommodation for multiple cassettes | mm | 200-300 |  |
|  | * Suitable for heat shrinkable connectors |  | yes |  |
| 1.9 | Temperature | 0C |  |  |
| 1.10 | Humidity | % |  |  |
| 1.11 | Protection Class |  | IP 65 or better |  |
| 1.12 | Minimum allowable bending radius for the optical fibres | mm |  |  |
| 1.13 | Weight of the joint box | kg |  |  |
| E | Vibration damper for OPGW/conductor |  |  |  |
| 1.0 | Manufacturer | - | - |  |
| 1.1a | Type – OPGW |  |  |  |
| 1.1b | Type – ACSR Conductor |  |  |  |
| 1.2 | Country of origin |  |  |  |
| 1.2 | Parts of iron material are galvanised | - | yes |  |
| 1.3 | Galvanising process |  | Hot dip |  |
| 1.4 | Material |  |  |  |
|  | Counterweights | material |  |  |
|  | Cable | material |  |  |
|  | Clamp body and keeper | material |  |  |
| 1.5a | OPGW diameter range | mm |  |  |
| 1.5 b | ACSR diameter ranger | mm |  |  |
| 1.6 | Maximum span for (OPGW/ ACSR conductor) |  |  |  |
|  | * One vibration damper at each end of the span |  |  |  |
|  | * Two vibration dampers at each end of the span |  |  |  |
|  | * Three vibration dampers at each end of the span |  |  |  |
| 1.7 | Dimensions from clamp mouth to vibration damper attachment (OPGW/ ACSR conductor) |  |  |  |
|  | * First damper |  |  |  |
|  | * Second damper when required |  |  |  |
|  | * Third damper when required |  |  |  |
| 1.9a | Weight of the damper- OPGW | kg |  |  |
| 1.9b | Weight of the damper – ACSR conductor | kg |  |  |
| 2.0 | Drawings |  |  |  |
| 2.1 | OPGW suspension assembly |  |  |  |
| 2.2 | OPGW suspension clamp |  |  |  |
| 2.3 | OPGW tension assembly |  |  |  |
| 2.4 | OPGW tension clamp |  |  |  |
| 2.5 | OPGW joint box, splices etc. |  |  |  |
| 2.6a | OPGW vibration dampers |  |  |  |
| 2.6b | ACSR conductor vibration dampers |  |  |  |
| 2.7 | OPGW hardware and fitting supply reference |  |  |  |
| 2.8 | Type test report |  |  |  |
| 3.0 | Standard |  |  |  |
| 3.1 | Manufacturing | - | BS 3288  BS 729  BSEN ISO1461  IEC61897 |  |
| 3.2 | Quality assurance | - | ISO 9001 |  |
| 4.0 | Installation | - | Outdoor tropical environment |  |
|  |  |  |  |  |

| **Technical Data Schedule**  **of AIRCRAFT WARNING PAINT/ WARNING SPHERES/ WARNING LIGHTS** | | | | |
| --- | --- | --- | --- | --- |
| ITEM | DESCRIPTION | UNITS | REQUIRED | GUARANTEED |
| A. | AIRCRAFT WARNING PAINT (Orange and White Painting on Tower Structure) |  |  |  |
| A.1 | Primer and touch up primer (epoxy zinc and phosphate primer) | - | - |  |
| 1.1 | Type | - | Epoxy polyamide cured |  |
| 1.2 | Total volume of solids min. | % | 50 |  |
| 1.3 | Dry film thickness | µm | 40-80 |  |
| 1.4 | Color |  | Red/brown |  |
| 1.5 | Color code RAL | code |  |  |
| 1.6 | Flash point ( tag open cup) | 0C |  |  |
| 1.7 | Drying time of coating |  |  |  |
|  | @ 200C | h |  |  |
|  | @ 500C | h |  |  |
| 1.8 | Type of thinner |  |  |  |
| 1.9 | Type of cleaner |  |  |  |
| A.2 | Intermediate coat (two – pack epoxy, micaceous iron oxide, polyamide cured) |  |  |  |
| 1.1 | Type |  | epoxy |  |
| 1.2 | Total Volume of solids (minimum) | % | 60 |  |
| 1.3 | Dry film thickness | µm | 100 |  |
| 1.4 | Color |  | Red/silver grey |  |
| 1.5 | Flash point ( tag open cup) | 0C |  |  |
| 1.6 | Drying time of coating |  |  |  |
|  | @ 200C | h |  |  |
|  | @ 500C | h |  |  |
| 1.7 | Type of thinner |  |  |  |
| 1.8 | Type of cleaner |  |  |  |
| A.3 | Final coat  (Two – pack acrylic resin, cured with linear isocyanate, high gloss) |  |  |  |
| 1.1 | Type |  | Aliphatic urethane gloss enamel |  |
| 1.2 | Total Volume of solids (minimum) |  |  |  |
|  | Orange | % | 55 |  |
|  | White | % | 55 |  |
| 1.3 | Dry film thickness |  |  |  |
|  | Orange (two coats) | µm | 50-75 |  |
|  | White (two coats) | µm | 50-75 |  |
| 1.4 | Color |  |  |  |
|  | * Orange | code | RAL 2002 |  |
|  | * White | code | RAL 9010 |  |
| 1.5 | Flash point (tag open cup) | 0C |  |  |
| 1.6 | Drying time of coating |  |  |  |
|  | @ 200C | h |  |  |
|  | @ 500C | h |  |  |
| 1.7 | Type of thinner |  |  |  |
| 1.8 | Type of cleaner |  |  |  |
| 1.9 | Drawings |  |  |  |
|  | Paint application procedure |  | yes |  |
| B | Aircraft Warning Spheres |  |  |  |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Type |  |  |  |
| 1.3 | Country of Origin |  |  |  |
| 1.4 | Fitted to |  | OPGW/GSW |  |
| 1.5 | Diameter | mm | 600 |  |
| 1.6 | Material |  | Fiber Glass |  |
| 1.7 | Color (non-fade able) | color | International Orange |  |
| 1.8 | Fitting material |  | Galvanised steel |  |
| 1.9 | Positioning |  | staggered |  |
| 1.10 | Spheres separation (according to local regulations) | m | 30 |  |
| 1.11 | Drawings |  |  |  |
|  | Aircraft warning spheres and accessories |  | yes |  |
|  | Supply reference |  | yes |  |
| C | Aircraft Warning Lights |  |  |  |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Type |  |  |  |
| 1.3 | Country of Origin |  |  |  |
| 1.4 | Rated voltage | V |  |  |
| 1.5 | Temperature range | 0C | 0-60 |  |
| 1.6 | Humidity | % | 100 |  |
| 1.7 | Obstruction lights type |  |  |  |
|  | ICAO Annex 14, low intensity | cd |  |  |
|  | Rated power | W |  |  |
| 1.8 | Photovoltaic modules |  |  |  |
|  | Type |  |  |  |
|  | Rated voltage | V |  |  |
|  | Rated peak output | W |  |  |
| 1.9 | Bird protection |  | yes |  |
| 1.10 | Dimensions |  |  |  |
|  | Length | mm |  |  |
|  | Width | mm |  |  |
|  | Depth | mm |  |  |
| 1.11 | Weight | kg |  |  |
| 1.12 | Number of modules per system | No. |  |  |
| 1.13 | Batteries |  |  |  |
|  | Type |  | Sealed maintenance free |  |
|  | Rated voltage | V |  |  |
|  | Capacity | Ah |  |  |
| 1.14 | Dimensions |  |  |  |
|  | Length | mm |  |  |
|  | Width | mm |  |  |
|  | Depth | mm |  |  |
| 1.11 | Weight | kg |  |  |
| 1.12 | Number of batteries per system | No. |  |  |
| 1.13 | Battery charge regulator |  | To suit battery characteristics |  |
| 1.14 | System enclosure |  | To protect all components from the atmosphere |  |
| 1.15 | Guarantee |  | 5 years of continuous operation |  |
| 2.0 | Drawings |  |  |  |
|  | Drawing of the arrangement of the aircraft warning lights |  | yes |  |
|  |  |  |  |  |

**PARTICULARS OF 132 kV TOWER FOUNDATIONS**

| **Tower** | **Qty** | **Per Tower** | | | | **Total for each soil class** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **type** |  | Excavation | Lean Concrete | Concrete | Rebar | Excavation | Lean Concrete | Concrete | Rebar |
|  |  | **m3** | **m3** | **m3** | **kgs** | **m3** | **m3** | **m3** | **kgs** |
| **132S-SC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132T30-SC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132T60-SC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132S-DC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132T10-DC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132T60-DC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132TT-DC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| Class 6 |  |  |  |  |  | - | - | - | - |
| **132SP-DC** |  |  |  |  |  |  |  |  |  |
| Class 1 |  |  |  |  |  | - | - | - | - |
| Class 2 |  |  |  |  |  | - | - | - | - |
| Class 3 |  |  |  |  |  | - | - | - | - |
| Class 4 |  |  |  |  |  | - | - | - | - |
| Class 5 |  |  |  |  |  | - | - | - | - |
| **Total** | - |  |  |  |  | - | - | - | - |

Note:

The excavation volume, concrete volume, reinforcement for each type of foundation should be clearly indicated in this schedule for double circuit 132kV towers. **Failure to submit this schedule will lead to rejection of the bid.** In case during the bid evaluation and clarification process it is observed that the bidder has underestimated foundation volumes, the bid shall be considered as non-response.

Name of Representative  ..................................................................…..

Signature: ..................................................................…..

Address: ...................................................................….

*Date: ...................................................................…..*

**Note: Only the person holding the power of attorney should sign this page. The page should be stamped with the company seal.**

**PARTICULARS OF 132 kV SINGLE CIRCUIT TOWERS**

| **TYPE OF TOWER** | **132S-SC** | **132T30-SC** | **132T60-SC** | **132S-DC** | **132T10-DC** | **132T60-DC** | **132TT-DC** | **132SP-DC** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Type of insulator set  Maximum angle of deviation degree  Standard span length m  Minimum ground clearance of line conductor at 80oC, Flat ground m  Set of line conductor in standard span length at 80oC m  Maximum distance of line conductor below cross arm m  Height above ground of bottom conductor Cross arm m  Minimum height of earth conductors above upper line Conductor at tower m  Vertical spacing between line conductor at tower:  Minimum m  Actual m  Overall tower height m  Clearance between conductors of one circuit hanging  Vertically and tower climbing leg of the circuit: -  Minimum m  Actual m  Horizontal distance, from tower centre line of earth  Conductors m  Longitudinal dimension of tower body a cross arm level m  Overall tower base dimension at ground line: -  (transverse) m  (longitudinal) m  Tower Weights including (fabricated parts, fasteners, Accessories Etc.)  Basic Body(Common parts)  +0M body extension  +3M body extension  +6M body extension  +9M body extension  -2M Leg extension  -1M Leg extension  +0M Leg extension  +1M Leg extension  +2M Leg extension | Suspension  2 | Tension  30 | Tension  60 | Suspension  2 | Tension  10 | Tension  60 | Tension  0-90  (0-45) | Tension  60(special) |

**Note: The Contractor should complete this table. Failure to complete this table will result in rejection of the bids**

In case during the bid evaluation and clarification process it is observed that the bidder has underestimated the tower weight, the bid shall be considered as non-res

1. # All flashover and withstand voltage levels corrected to normal temperature and pressure in accordance with IEC 60383 [↑](#footnote-ref-1)
2. # All flashover and withstand voltage levels corrected to normal temperature and pressure in accordance with IEC 60383 [↑](#footnote-ref-2)
3. [↑](#footnote-ref-3)