* 1. **220 kV Technical Data Sheets For Busbars And Connections**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **BUSBARS AND CONNECTIONS** | **Unit** | **Required** | **Provided** |
| 1.1 | Manufacturer |  |  |  |
| 1.2 | Type (flexible or tubular) |  |  |  |
| 1.3 | Material |  |  |  |
| 1.4 | Short-circuit current rating / duration | kA/s | 40/1 |  |
| 1.5 | Normal current rating |  |  |  |
|  | at 40oC | A | 2000 |  |
|  | at 50oC | A |  |  |
| 1.6 | Maximum continuous current rating | A |  |  |
| 1.7 | Flexible conductors |  |  |  |
|  | stranding |  |  |  |
|  | nominal cross-sectional area | mm2 |  |  |
|  | outer diameter | mm |  |  |
|  | no. of conductors per bundle |  |  |  |
|  | spacing between conductors | mm |  |  |
| 1.8 | Tubular conductors |  |  |  |
|  | nominal cross-sectional area | mm2 |  |  |
|  | outer diameter | mm |  |  |
|  | inner diameter | mm |  |  |
| 1.9 | Maximum stress at surface of flexible conductor | kV/mm |  |  |
| 1.10 | Radio influence voltage level measured at 1.1 times Us/√3 at 1 MHz | µV |  |  |
| 1.11 | Manufacturer quality system in accordance with ISO 9000 | Yes/No | Yes |  |
|  | Date of issue |  | Latest |  |
|  | Validity |  |  |  |
|  | Certificate attached to the offer | Yes/No | Yes |  |
| 1.12 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate to be submitted | Yes/No | Yes |  |
|  | Certificate to be attached to the offer | Yes/No | Yes |  |
|  | Report to be attached to the offer | Yes/No | Yes |  |

**10.0 TECHNICAL DATA SHEETS FOR LOW VOLTAGE SWITCHGEAR**

| **LV Services Equipment** | **UNIT** | **DATA** |
| --- | --- | --- |
| **Required** | **Offered** |
| 1. | LVAC SWITCHGEAR (415/240 V, 50 HZ) |  |  |  |
| 1.1 | GENERAL |  |  |  |
| 1.1.1 | Network configuration |  | TN-S |  |
| 1.1.2 | Rated operating voltage | V | 415 |  |
| 1.1.3 | Rated frequency | Hz | 50 |  |
| 1.2 | LVAC SWITCHBOARD |  |  |  |
| 1.2.1 | Manufacturer |  |  |  |
| 1.2.2 | Type designation |  |  |  |
| 1.2.3 | Type of switchboard |  | Metal-clad, withdrawable type, multi-tier |  |
| 1.2.4 | Standards |  | IEC 61439 |  |
| 1.2.5 | Number of years equipment of identical design has been in service |  | 5 |  |
| 1.2.6 | Rated current of busbar at 40C ambient temperature | A | 1200 |  |
| 1.2.7 | Busbar cross section | mm2 |  |  |
| 1.2.8 | Busbar insulation material  |  |  |  |
| 1.2.9 | Busbar insulation maximum working temperature | C |  |  |
| 1.2.10 | Temperature rise on continuous operation  |  |  |  |
|  | at rated current |  |  |  |
|  | at 50C |  |  |  |
| 1.2.11 | Rated short-time withstand current (1 s),  | kA | ≥50 |  |
| 1.2.12 | Rated peak withstand current | kA | ≥125 |  |
| 1.2.13 | Test voltage (1 min) | V | 2500 |  |
| 1.2.14 | Rated insulation voltage | V | 1000 |  |
| 1.2.15. | Rated impulse withstand voltage | kVp |  |  |
| 1.2.16 | Overvoltage category |  | IV |  |
| 1.2.17 | Form of separation |  | 3b |  |
| 1.2.18 | Painting | RAL | 7035 |  |
| 1.2.19 | Type of internal barriers, shutters, etc. |  | Metallic |  |
| 1.2.20 | Degree of protection |  | IP51 |  |
| 1.2.21 | Overall dimensions per cubicle |  |  |  |
|  | Width | mm |  |  |
|  | Depth | mm |  |  |
|  | Height | mm | max 2250 |  |
|  | Weight | kg |  |  |
| 1.2.22 | Method of circuit breaker withdrawal |  | manual |  |
| 1.3 | CIRCUIT BREAKER |  |  |  |
| 1.3.1 | Manufacturer |  |  |  |
| 1.3.2 | Type designation |  |  |  |
| 1.3.3 | Type |  | Air, withdrawable |  |
| 1.3.4 | Number of poles |  | 3 |  |
| 1.3.5 | Standard |  | IEC 60947-2 |  |
| 1.3.6 | Rated current at 50C | A |  |  |
| 1.3.7 | Rated short-time withstand current (1 s) | kA |  |  |
| 1.3.8 | Rated peak withstand current | kA |  |  |
| 1.3.9 | Rated symmetrical breaking current | kA |  |  |
| 1.3.10 | Rated making current | kA |  |  |
| 1.3.11 | Breaking time | s |  |  |
| 1.3.12 | Material of: |  |  |  |
|  | moving contacts |  |  |  |
|  | fixed contacts |  |  |  |
| 1.3.13 | Design of: |  |  |  |
|  | moving contacts |  |  |  |
|  | fixed contacts |  |  |  |
| 1.3.14 | Operating mechanism |  |  |  |
|  | Motor rated power | W |  |  |
|  | Motor operating voltage | V |  |  |
| 1.3.15 | Weight of draw-out unit | kg |  |  |
| 1.3.16 | Protection Module |  |  |  |
|  | Type |  |  |  |
|  | Phase protection functions |  | L,S,I |  |
|  | Neutral protection functions |  |  |  |
|  | Ground/Earth protection functions |  | G |  |
| 1.3.17 | Remote Signalling |  | Yes |  |
| 1.3.18. | Type tests |  |  |  |
| 1.3.18.1 | Temperature Rise Test |  |  |  |
|  | Have heating tests at continuous rated normal current been carried out? |  |  |  |
|  | report number |  |  |  |
|  | date |  |  |  |
| 1.3.18.2 | Basic Impulse Voltage Type Test: |  |  |  |
|  | Has B.I.V test been completed? |  |  |  |
|  | circuit breaker |  |  |  |
|  | report number |  |  |  |
|  | date |  |  |  |
| 1.3.18.3 | Life Test: |  |  |  |
|  | Has 2000 operating life test at no load (de-energised) been carried out? |  |  |  |
|  | report number |  |  |  |
|  | date |  |  |  |
| 1.4 | MOULDED CASE CIRCUIT BREAKERS (MCCBs) |  |  |  |
| 1.4.1 | Manufacturer |  |  |  |
| 1.4.2 | Type designation |  |  |  |
| 1.4.3 | Withdrawable MCCBs type |  | yes |  |
| 1.4.4 | Number of poles |  | 3 |  |
| 1.4.5 | Standards |  | IEC 60947-2 |  |
| 1.4.6 | Rated current at 50C | A |  |  |
| 1.4.7 | Rated short-time withstand current (1 s) | kA |  |  |
| 1.4.8 | Rated peak withstand current | kA |  |  |
| 1.4.9 | Rated breaking current | kA |  |  |
| 1.4.10 | Remote signalling | Yes/No | Yes |  |
| 1.4.11 | Operating mechanism |  |  |  |
| 1.4.12 | Mass |  |  |  |
| 1.4.13 | Protection Module |  |  |  |
|  | Type |  |  |  |
|  | Phase protection functions |  | L, I |  |
|  | Ground (Earth) protection function |  |  |  |
| 1.5 | CURRENT TRANSFORMERSNote: CT data need to be confirmed by contractor’s calculation |  |  |  |
| 1.5.1 | Manufacturer |  |  |  |
| 1.5.2 | Type |  |  |  |
| 1.5.3 | Type of primary winding (e.g. bar, wound, etc.) |  |  |  |
| 1.5.4 | Standards |  | IEC 61869 |  |
| 1.5.5 | Rated voltage | kV |  |  |
| 1.5.6 | Rated lightning impulse withstand voltage phase to earth | kV |  |  |
| 1.5.7 | Rated power frequency withstand voltage phase to earth | kV |  |  |
| 1.5.8 | Partial discharge test voltage | kV |  |  |
| 1.5.9 | Rated frequency | Hz | 50 |  |
| 1.5.10 | Rated continuous thermal current at 50°C |  |  |  |
| 1.5.11 | Rated short-time withstand current (1 s) | kA |  |  |
| 1.5.12 | Rated dynamic current | kA |  |  |
| 1.5.13 | Type designation |  |  |  |
| 1.5.14 | Number of cores |  | 3 |  |
| 1.5.15 | Rated extended primary current  | % | 120 |  |
| 1.5.16 | Ratio (TR = turns ratio) |  |  |  |
|  | I core | A | 750/1 |  |
|  | II core | A | 750/1 |  |
|  | III core | A | 750/1 |  |
| 1.5.17 | Class |  |  |  |
|  | I core |  | 5P20 |  |
|  | II core |  | PX |  |
|  | III core |  | 1.0 / FS:5 |  |
| 1.5.18 | Knee point voltage (EK) |  |  |  |
|  | I core | V |  |  |
|  | II core | V |  |  |
|  | III core | V |  |  |
| 1.5.19 | Exciting current (IE) at EK |  |  |  |
|  | I core | A |  |  |
|  | II core | A |  |  |
|  | III core | A |  |  |
| 1.5.20 | Rated output (burden to be 25-100% rated burden |  |  |  |
|  | I core | VA | 30 |  |
|  | II core | VA | 30 |  |
|  | III core | VA | 30 |  |
| 1.5.21 | Total mass of one current transformer complete | kg |  |  |
| 1.5.22 | All Class PX CTs shall have a rated secondary current, ISN |  |  |  |
| 1.6 | INSTRUMENTS |  |  |  |
| 1.6.1 | Manufacturer |  |  |  |
| 1.6.2 | Standards |  | IEC 60051 |  |
| 1.6.3 | Type designation |  |  |  |
|  | Ammeter |  |  |  |
|  | Voltmeter |  |  |  |
| 1.6.4 | Total scale range |  |  |  |
|  | Ammeter |  |  |  |
|  | Voltmeter |  |  |  |
| 1.6.5 | Dimensions | mm | 96 x 96 |  |
| 1.6.6 | Accuracy |  | 1.5 |  |
| 1.6.7 | Selector Switches |  |  |  |
|  | Ammeter |  |  |  |
|  | Voltmeter |  |  |  |
| 1.7 | PROTECTION |  |  |  |
| 1.7.1 | Overcurrent & Earth Fault Protection (50/51/50N/51N) Relay |  |  |  |
| 1.7.1.1 | Manufacturer |  |  |  |
| 1.7.1.2 | Type reference |  |  |  |
| 1.7.1.3 | Relay design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 1.7.1.4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88150 |  |
| 1.7.1.5 | Input frequency range (50Hz nominal) | Hz | 47.552.5 |  |
| 1.7.1.6 | Number of phase CT inputs |  |  |  |
| 1.7.1.7 | Number of earth fault CT inputs |  |  |  |
| 1.7.1.8 | Characteristics curves conforming to IEC 60255, ANSI | Yes/No | Yes |  |
| 1.7.1.9 | Number of overcurrent functions (e.g. No. lowset, high set, IDMTL) |  |  |  |
| 1.7.1.10 | Number of earth fault functions |  |  |  |
| 1.7.1.11 | Number of group settings |  |  |  |
| 1.7.1.12 | Earth fault element suitable of high impedance REF (with external resistor) | Yes/No | Yes |  |
| 1.7.1.13 | 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) |  |  |  |
| 1.7.1.14 | 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 |  |
| 1.7.1.15 | Communications |  |  |  |
|  | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | IEC 61850 | Yes/No | Yes |  |
|  | Others (please state) |  |  |  |
| 1.7.1.16 | 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 |  |  |  |
|  | IEC 60529 |  | IP50 |  |
|  | 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 60255-27– Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage IEC 60255-27test 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 60255-26](https://webstore.iec.ch/publication/1171) | Yes/No | Yes |  |
|  | Fast Transient Disturbance [IEC 60255-26](https://webstore.iec.ch/publication/1171)severity level IV | Yes/No | Yes |  |
|  | Type test certificate provided | Yes/No | Yes |  |
| 1.7.2 | Restricted Earth Fault Protection Relay (87NLE) |  |  |  |
| 1.7.2.1 | Manufacturer |  |  |  |
| 1.7.2.2 | Type reference |  |  |  |
| 1.7.2.3 | Relay design (microprocessor-based, numerical) | Yes/No | Yes |  |
| 1.7.2.4 | Auxiliary voltage range (Vn = 110Vdc) | Vdc | 88150 |  |
| 1.7.2.5 | Input frequency range (50Hz nominal) | Hz | 47.552.5 |  |
| 1.7.2.6 | Number of phase CT inputs |  |  |  |
| 1.7.2.7 | Number of earth CT inputs |  |  |  |
| 1.7.2.8 | Minimum fault setting (% of CT rating) | % |  |  |
| 1.7.2.9 | Operating time at 5 x setting | ms |  |  |
| 1.7.2.10 | State principle of operation, i.e.H - high impedanceL - low impedance | H, L | H |  |
| 1.7.2.11 | Current transformer requirements: |  |  |  |
|  | Required knee point voltage, Vk | V |  |  |
|  | CT maximum winding resistance |  |  |  |
|  | Magnetising current at Vk | A |  |  |
| 1.7.2.12 | Other protection functions: |  |  |  |
|  | Overvoltage protection (59) | Yes/No | Yes |  |
|  | Undervoltage protection | Yes/No | Yes |  |
| 1.7.2.13 | 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) |  |  |  |
| 1.7.2.14 | 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 |  |
| 1.7.2.15 | Communications |  |  |  |
|  | Control |  |  |  |
|  | Communication ports (Front/rear etc.) |  |  |  |
|  | Physical links (RS485/Fibre optic) |  | Fibre optic |  |
|  | Protocols supported |  |  |  |
|  | IEC 61850 | Yes/No | Yes |  |
|  | Others (please state) |  |  |  |
| 1.7.2.16 | 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 |  |  |  |
|  | IEC 60529 |  | IP50 |  |
|  | 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 60255-27 – Series C of table 1 | Yes/No | Yes |  |
|  | Impulse voltage IEC 60255-27 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 60255-26 | Yes/No | Yes |  |
|  | Fast Transient Disturbance IEC 60255-26 severity level IV | Yes/No | Yes |  |
|  | Type test certificate provided | Yes/No | Yes |  |
| 1.7.3 | Undervoltage Relay |  |  |  |
| 1.7.3.1. | Manufacturer |  |  |  |
| 1.7.3.2. | Type reference |  |  |  |
| 1.7.3.3. | Relay design (electromechanical, static) |  |  |  |
| 1.7.3.4. | Total scale range | V |  |  |
| 1.7.3.5. | Operate time at instantaneous voltage change | ms |  |  |
| 1.7.3.6. | Reset ratio | % |  |  |
| 1.8 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 1.9 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| 2. | 110 V D.C SYSTEM - SUBSTATION SERVICES SUPPLY |  |  |  |
| 2.1 | 110 V Battery Units |  |  |  |
| 2.1.1 | Manufacturer |  |  |  |
| 2.1.2 | Type designation |  |  |  |
| 2.1.3 | Number of battery units |  | 2 x 50% |  |
| 2.1.4 | Type of cell |  | Nickel-Cadmium |  |
| 2.1.5 | Operating voltage per cell | V | 1.2 |  |
| 2.1.6 | Number of cells |  |  |  |
| 2.1.7 | Standard |  | \* IEEE 1115 for calculation\* IEC 60623, 61204, 61439 for equipment |  |
| 2.1.8 | Discharge capacity:  |  |  |  |
|  | 10 hour rate | Ah | min. 900 (to be confirmed by calculation) |  |
|  | 5 hour rate | Ah |  |  |
|  | 3 hour rate | Ah |  |  |
|  | 1 hour rate | Ah |  |  |
|  | 30 minute rate | Ah |  |  |
| 2.1.9 | Final cell voltage after discharge: |  |  |  |
|  | 10 hour rate | V | 1.14 |  |
|  | 5 hour rate | V |  |  |
|  | 3 hour rate | V |  |  |
|  | 1 hour rate | V |  |  |
|  | 30 minute rate | V |  |  |
| 2.1.10 | Ampere hour efficiency: |  |  |  |
|  | 10 hour rate | % |  |  |
|  | 5 hour rate | % |  |  |
|  | 3 hour rate | % |  |  |
|  | 1 hour rate | % |  |  |
| 2.1.11 | Watt hour efficiency: |  |  |  |
|  | 10 hour rate | % |  |  |
|  | 5 hour rate | % |  |  |
|  | 3 hour rate | % |  |  |
|  | 1 hour rate | % |  |  |
|  | 30 minute rate | % |  |  |
| 2.1.12 | Maximum charging voltage per cell | V |  |  |
| 2.1.13 | Normal charging rate range | A |  |  |
| 2.1.14 | Maximum charging rate range | A |  |  |
| 2.1.15 | Float charging rate | A |  |  |
| 2.1.16 | Boost charging rate | A |  |  |
| 2.1.17 | Normal voltage across battery on float charge | V |  |  |
| 2.1.18 | Voltage per cell on float charge | V |  |  |
| 2.1.19 | Normal voltage across battery on boost charge | V |  |  |
| 2.1.20 | Voltage per cell on boost charge | V |  |  |
| 2.1.21 | Overall dimensions of one cell | mm |  |  |
| 2.1.22 | Quantity of electrolyte per cell | Litres |  |  |
| 2.1.23 | Overall dimensions of each stand | mm |  |  |
| 2.1.24 | Number of stands |  |  |  |
| 2.1.25 | Number of tiers |  |  |  |
| 2.1.26 | Material and cross section of connections: |  |  |  |
|  | between cells | mm2 |  |  |
|  | between tiers | mm2 |  |  |
|  | between stands | mm2 |  |  |
|  | to battery fuse box | mm2 |  |  |
| 2.1.27 | Method of treating copper connection against corrosion |  |  |  |
| 2.1.28 | Method of protecting copper connections against accidental short circuiting |  |  |  |
| 2.1.29 | Estimated short circuit current from fully charged battery | A |  |  |
| 2.1.30 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 2.1.31 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 2.1.32 | Operating temperatures: |  |  |  |
|  | Normal operation maximum | C |  |  |
|  | Normal operation minimum | C |  |  |
|  | Emergency discharge maximum | C |  |  |
|  | Emergency discharge minimum | C |  |  |
| 2.2 | 110 V D.C Battery Chargers |  |  |  |
| 2.2.1 | Manufacturer |  |  |  |
| 2.2.2 | Type designation |  |  |  |
| 2.2.3 | Panel |  |  |  |
|  | Degree of protection |  | IP 51 |  |
|  | Painting | RAL | 7035 |  |
| 2.2.4 | Number of chargers |  | 2 x 100% |  |
| 2.2.5 | Type |  | Thyristor Controlled |  |
| 2.2.6 | Charging characteristic |  |  |  |
| 2.2.7 | Input voltage and range | V | 3 Phase, 415, ±25% |  |
| 2.2.8 | Input frequency and range | Hz | 50, ±5% |  |
| 2.2.9 | Input power | kVA |  |  |
| 2.2.10 | Minimum working power factor |  |  |  |
| 2.2.11 | Rated output power | kW |  |  |
| 2.2.12 | Output voltage range: |  |  |  |
|  | float charge | V |  |  |
|  | boost charge | V |  |  |
| 2.2.13 | Continuous output current range: |  |  |  |
|  | float charge | A |  |  |
|  | boost charge | A |  |  |
| 2.2.14 | Accuracy of output voltage within a load range between 0 % and 100 % of the unit current | % |  |  |
| 2.2.15 | Overload range | % |  |  |
| 2.2.16 | Voltage ripple | % |  |  |
| 2.2.17 | Ripple frequency | Hz |  |  |
| 2.2.18 | Means of adjusting output |  |  |  |
| 2.2.19 | Details of any forced cooling equipment for chargers |  |  |  |
| 2.2.20 | Ambient temperature range | C |  |  |
| 2.2.21 | Ambient relative humidity range | % |  |  |
| 2.2.22 | Mean time between failure (MTBF) | Years | 25 |  |
| 2.2.23 | Overall dimensions (shall be a separate free-standing panel/cubicle) | mm |  |  |
| 2.2.24 | Weight | kg |  |  |
| 2.2.25 | Boost charge maximum permitted constant potential per cell | V |  |  |
| 2.2.26 | Boost charge maximum permitted current as percentage of 5 hour capacity | % |  |  |
| 2.2.27 | Time to be re-charge to 90% capacity at maximum permitted voltage and current | hrs |  |  |
| 2.3. | Battery Fuse Boxes |  |  |  |
| 2.3.1 | Manufacturer |  |  |  |
| 2.3.2 | Type designation |  |  |  |
| 2.3.3 | Degree of protection |  | IP 51 |  |
| 2.3.4 | Fuse rated current at 50oC |  |  |  |
| 2.3.5 | Remote signalling | Yes/No | Yes |  |
| 2.3.6 | Dimensions of box | mm |  |  |
| 2.4 | 110 V D.C. Switchboards |  |  |  |
| 2.4.1 | Manufacturer |  |  |  |
| 2.4.2 | Type designation  |  |  |  |
| 2.4.3 | Panels |  |  |  |
|  | Degree of protection |  | IP 51 |  |
|  | Painting | RAL | 7035 |  |
|  | Form of separation |  | 3b |  |
| 2.4.4 | Standards |  | IEC 61439 |  |
| 2.4.5 | Rated operating voltage | V | 110 |  |
| 2.4.6 | Rated current of busbars at 50oC ambient temperature | A |  |  |
| 2.4.7 | Busbar cross section | mm2 |  |  |
| 2.4.8 | Busbar insulation material |  |  |  |
| 2.4.9 | Number of circuits |  |  |  |
| 2.4.10 | Main isolator rating | A |  |  |
| 2.4.11 | Main fuse rating | A |  |  |
| 2.4.12 | Single line diagram number |  |  |  |
| 2.4.13 | Arrangement drawing number |  |  |  |
| 2.4.14 | 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 |  |  |  |
| 2.4.15 | Details of Earth Fault Protection: |  |  |  |
|  | Manufacturer |  |  |  |
|  | Type Designation |  |  |  |
|  | Brochure number |  |  |  |
| 2.4.16 | Details of Undervoltage / Overvoltage Protection: |  |  |  |
|  | Manufacturer |  |  |  |
|  | Type Designation |  |  |  |
|  | Brochure number |  |  |  |
| 2.4.17 | Instruments |  |  |  |
|  | Manufacturer |  |  |  |
|  | Voltmeter (type) |  |  |  |
|  | Ammeter (type) |  |  |  |
|  | Instruments |  |  |  |
| 2.4.18 | 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 |  |
| 2.4.19 | 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 |  |
| 2.5 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 2.6 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| 3. | 48 V D.C SYSTEM - SUBSTATION SERVICES SUPPLY |  |  |  |
| 3.1 | 48 V Battery Units |  |  |  |
| 3.1.1 | Manufacturer |  |  |  |
| 3.1.2 | Type designation |  |  |  |
| 3.1.3 | Number of battery units |  | 2 x 50% |  |
| 3.1.4 | Type of cell |  | Nickel-Cadmium |  |
| 3.1.5 | Operating voltage per cell | V | 1.2 |  |
| 3.1.6 | Number of cells |  |  |  |
| 3.1.7 | Standard |  | \* IEEE 1115 for calculation\* IEC 60623, 61204, 61439 for equipment |  |
| 3.1.8 | Discharge capacity:  |  |  |  |
|  | 12 hour rate | Ah | min. 200 (to be confirmed by calculation) |  |
|  | 5 hour rate | Ah |  |  |
|  | 3 hour rate | Ah |  |  |
|  | 1 hour rate | Ah |  |  |
|  | 30 minute rate | Ah |  |  |
| 3.1.9 | Final cell voltage after discharge: |  |  |  |
|  | 10 hour rate | V | 1.14 |  |
|  | 5 hour rate | V |  |  |
|  | 3 hour rate | V |  |  |
|  | 1 hour rate | V |  |  |
|  | 30 minute rate | V |  |  |
| 3.1.10 | Ampere hour efficiency: |  |  |  |
|  | 10 hour rate | % |  |  |
|  | 5 hour rate | % |  |  |
|  | 3 hour rate | % |  |  |
|  | 1 hour rate | % |  |  |
| 3.1.11 | Watt hour efficiency: |  |  |  |
|  | 10 hour rate | % |  |  |
|  | 5 hour rate | % |  |  |
|  | 3 hour rate | % |  |  |
|  | 1 hour rate | % |  |  |
|  | 30 minute rate | % |  |  |
| 3.1.12 | Maximum charging voltage per cell | V |  |  |
| 3.1.13 | Normal charging rate range | A |  |  |
| 3.1.14 | Maximum charging rate range | A |  |  |
| 3.1.15 | Float charging rate | A |  |  |
| 3.1.16 | Boost charging rate | A |  |  |
| 3.1.17 | Normal voltage across battery on float charge | V |  |  |
| 3.1.18 | Voltage per cell on float charge | V |  |  |
| 3.1.19 | Normal voltage across battery on boost charge | V |  |  |
| 3.1.20 | Voltage per cell on boost charge | V |  |  |
| 3.1.21 | Overall dimensions of one cell | mm |  |  |
| 3.1.22 | Quantity of electrolyte per cell | Litres |  |  |
| 3.1.23 | Overall dimensions of each stand | mm |  |  |
| 3.1.24 | Number of stands |  |  |  |
| 3.1.25 | Number of tiers |  |  |  |
| 3.1.26 | Material and cross section of connections: |  |  |  |
|  | between cells | mm2 |  |  |
|  | between tiers | mm2 |  |  |
|  | between stands | mm2 |  |  |
|  | to battery fuse box | mm2 |  |  |
| 3.1.27 | Method of treating copper connection against corrosion |  |  |  |
| 3.1.28 | Method of protecting copper connections against accidental short circuiting |  |  |  |
| 3.1.29 | Estimated short circuit current from fully charged battery | A |  |  |
| 3.1.30 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 3.1.31 | Anticipated life of electrolyte under actual operating conditions | Years |  |  |
| 3.1.32 | Operating temperatures: |  |  |  |
|  | Normal operation maximum | C |  |  |
|  | Normal operation minimum | C |  |  |
|  | Emergency discharge maximum | C |  |  |
|  | Emergency discharge minimum | C |  |  |
| 3.3 | 48 V D.C Battery Chargers |  |  |  |
| 3.3.1 | Manufacturer |  |  |  |
| 3.3.2 | Type designation |  |  |  |
| 3.3.3 | Panel |  |  |  |
|  | Degree of protection |  | IP 51 |  |
|  | Painting | RAL | 7035 |  |
| 3.3.4 | Number of chargers |  | 2 x 100% |  |
| 3.3.5 | Type |  | Thyristor Controlled |  |
| 3.3.6 | Charging characteristic |  |  |  |
| 3.3.7 | Input voltage and range | V | 3 Phase, 415, ±25% |  |
| 3.3.8 | Input frequency and range | Hz | 50, ±5% |  |
| 3.3.9 | Input power | kVA |  |  |
| 3.3.10 | Minimum working power factor |  |  |  |
| 3.3.11 | Rated output power | kW |  |  |
| 3.3.12 | Output voltage range: |  |  |  |
|  | float charge | V |  |  |
|  | boost charge | V |  |  |
| 3.3.13 | Continuous output current range: |  |  |  |
|  | float charge | A |  |  |
|  | boost charge | A |  |  |
| 3.3.14 | Accuracy of output voltage within a load range between 0 % and 100 % of the unit current | % |  |  |
| 3.3.15 | Overload range | % |  |  |
| 3.3.16 | Voltage ripple | % |  |  |
| 3.3.17 | Ripple frequency | Hz |  |  |
| 3.3.18 | Means of adjusting output |  |  |  |
| 3.3.19 | Details of any forced cooling equipment for chargers |  |  |  |
| 3.3.20 | Ambient temperature range | C |  |  |
| 3.3.21 | Ambient relative humidity range | % |  |  |
| 3.3.22 | Mean time between failure (MTBF) | Years | 25 |  |
| 3.3.23 | Overall dimensions (shall be a separate free-standing panel/cubicle) | mm |  |  |
| 3.3.24 | Weight | kg |  |  |
| 3.3.25 | Boost charge maximum permitted constant potential per cell | V |  |  |
| 3.3.26 | Boost charge maximum permitted current as percentage of 5 hour capacity | % |  |  |
| 3.3.27 | Time to be re-charge to 90% capacity at maximum permitted voltage and current | hrs |  |  |
| 3.3. | Battery Fuse Boxes |  |  |  |
| 3.3.1 | Manufacturer |  |  |  |
| 3.3.2 | Type designation |  |  |  |
| 3.3.3 | Degree of protection |  | IP 51 |  |
| 3.3.4 | Fuse rated current at 50oC |  |  |  |
| 3.3.5 | Remote signalling | Yes/No | Yes |  |
| 3.3.6 | Dimensions of box | mm |  |  |
| 3.4 | 48 V D.C. Switchboards |  |  |  |
| 3.4.1 | Manufacturer |  |  |  |
| 3.4.2 | Type designation  |  |  |  |
| 3.4.3 | Panels |  |  |  |
|  | Degree of protection |  | IP 51 |  |
|  | Painting | RAL | 7035 |  |
|  | Form of separation |  | 3b |  |
| 3.4.4 | Standards |  | IEC 61439 |  |
| 3.4.5 | Rated operating voltage | V | 48 |  |
| 3.4.6 | Rated current of busbars at 50°C ambient temperature | A |  |  |
| 3.4.7 | Busbar cross section | mm2 |  |  |
| 3.4.8 | Busbar insulation material |  |  |  |
| 3.4.9 | Number of circuits |  |  |  |
| 3.4.10 | Main isolator rating | A |  |  |
| 3.4.11 | Main fuse rating | A |  |  |
| 3.4.12 | Single line diagram number |  |  |  |
| 3.4.13 | Arrangement drawing number |  |  |  |
| 3.4.14 | 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 |  |  |  |
| 3.4.15 | Details of Earth Fault Protection: |  |  |  |
|  | Manufacturer |  |  |  |
|  | Type Designation |  |  |  |
|  | Brochure number |  |  |  |
| 3.4.16 | Details of Undervoltage / Overvoltage Protection: |  |  |  |
|  | Manufacturer |  |  |  |
|  | Type Designation |  |  |  |
|  | Brochure number |  |  |  |
| 3.4.17 | Instruments |  |  |  |
|  | Manufacturer |  |  |  |
|  | Voltmeter (type) |  |  |  |
|  | Ammeter (type) |  |  |  |
|  | Instruments |  |  |  |
| 3.4.18 | 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 |  |
| 3.4.19 | 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 |  |
| 3.5 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 3.6 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| 4. | 240 V AC UNINTERRUPTIBLE POWER SUPPLY |  |  |  |
| 4.1 | GENERAL |  |  |  |
| 4.1.1 | The uninterruptible power supply (UPS) shall consist but not be limited to the following items: |  |  |  |
|  | two thyristor controlled 110 V DC / 415 V AC inverters | Yes/No | Yes |  |
|  | two static interrupters and transfer switches | Yes/No | Yes |  |
|  | one 240/240 V three phase isolating by-pass transformer | Yes/No | Yes |  |
|  | two manual by-pass switches | Yes/No | Yes |  |
|  | one UPS distribution board | Yes/No | Yes |  |
| 4.2 | INVERTER |  |  |  |
| 4.2.1 | Manufacturer |  |  |  |
| 4.2.2 | Type designation |  |  |  |
| 4.2.3 | Degree of protection/RAL code |  | IP51/RAL 7035 |  |
| 4.2.4 | Rated output power | VA | min 6000 (to be confirmed by calculation) |  |
| 4.2.5 | Rated input voltage and range | V% |  |  |
| 4.2.6 | Rated input current | A |  |  |
| 4.2.7 | Rated output voltage | V |  |  |
| 4.2.8 | Steady state voltage variation | % |  |  |
| 4.2.9 | Rated output current | A |  |  |
| 4.2.10 | Rated output frequency | Hz |  |  |
| 4.2.11 | Steady state frequency variation | % |  |  |
| 4.2.12 | Total harmonic distortion | % |  |  |
| 4.2.13 | Rated output power factor |  |  |  |
| 4.2.14 | Maximum harmonic distortion: |  |  |  |
|  | at any single frequency | % |  |  |
|  | at all frequencies | % |  |  |
| 4.2.15 | Radio frequency interference (RFI) classification |  |  |  |
| 4.2.16 | Output voltage rise time on turn-on | ms |  |  |
| 4.2.17 | Output voltage decay time on turn-off | ms |  |  |
| 4.2.18 | Maximum transient voltage variation after full load acceptance or rejection for: |  |  |  |
|  | 1 cycle | % |  |  |
|  | 0.1 s | % |  |  |
|  | 1 s | % |  |  |
| 4.2.19 | Method of cooling |  |  |  |
| 4.2.1 | Ambient temperature range | C |  |  |
| 4.2.20 | Maximum temperature rise (inside) | C |  |  |
| 4.2.21 | Ambient relative humidity | % |  |  |
| 4.2.22 | Method of protecting inverters against high intensity D.C voltage surges |  |  |  |
| 4.2.23 | Mean time between failure (MTBF) | Years | 25 |  |
| 4.2.24 | Dimensions | mm |  |  |
| 4.2.25 | Weight | kg |  |  |
| 4.3 | STATIC SWITCH |  |  |  |
| 4.3.1 | Bidder shall fulfil the detailed description of offered static switch possibility with data and diagram |  |  |  |
| 4.4 | ISOLATION BY-PASS TRANSFORMER |  |  |  |
| 4.4.1 | Manufacturer |  |  |  |
| 4.4.2 | Standard applied |  |  |  |
| 4.4.3 | Type designation |  |  |  |
| 4.4.4 | Maximum continuous capacity | VA |  |  |
| 4.4.5 | Number of phase | 1 |  |  |
| 4.4.6 | Rated voltage under full load | V |  |  |
| 4.4.7 | Protection class | IP |  |  |
| 4.4.8 | Dimensions overall | mm |  |  |
| 4.4.9 | Total weight | kg |  |  |
| 4.5 | MANUAL BY-PASS SWITCH |  |  |  |
| 4.5.1 | Manufacturer |  |  |  |
| 4.5.2 | Type of designation |  |  |  |
| 4.5.3 | Rated current at 50°C | A |  |  |
| 4.6 | DISTRIBUTION BOARD |  |  |  |
| 4.6.1 | Manufacturer |  |  |  |
| 4.6.2 | Type designation |  |  |  |
| 4.6.3 | Degree of protection/RAL code |  | IP 51/RAL 7035 |  |
| 4.6.4 | Busbar insulation material |  |  |  |
| 4.6.5 | Number of circuits |  |  |  |
| 4.6.6 | 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 |  |
| 4.6.7 | 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 |  |
| 4.7 | Manufacturer quality system in accordance with ISO 9000, 9001, 9002, 9003 and 9004 | Yes/No | Yes |  |
| 4.8 | Type test certificate to be issued by independent laboratory or independently witnessed type test certificate available | Yes/No | Yes |  |
| 5. | AUXILIARY BCU |  |  |  |
|  | Hardware and software type same as BCUs specified in chapter “SUBSTATION CONTROL SYSTEM” | 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 |  |  |
|  | mA analog inputs |  |  |  |
|  | Number |  |  |  |
|  | Range | mA | 4-20 |  |